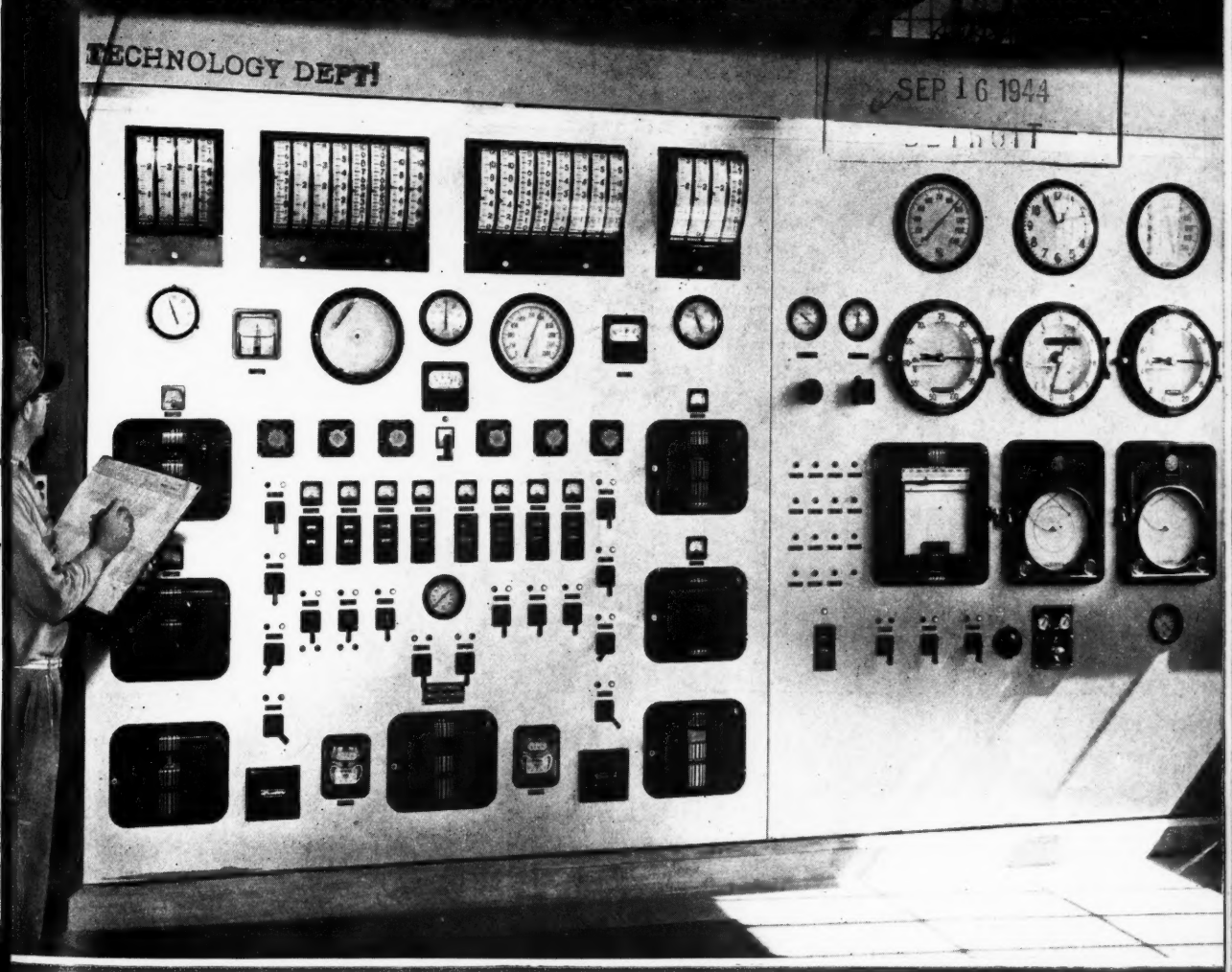
POWER PLANT ENGINEERING

THE POWER ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY



Shasta Dam Power Plant
Selecting And Installing Heat Insulation
Modern Equipment Aids System Savings
Causes Of Turbine Vibration
Case Of The Hot Bearing

For Other Articles See Contents Page 5

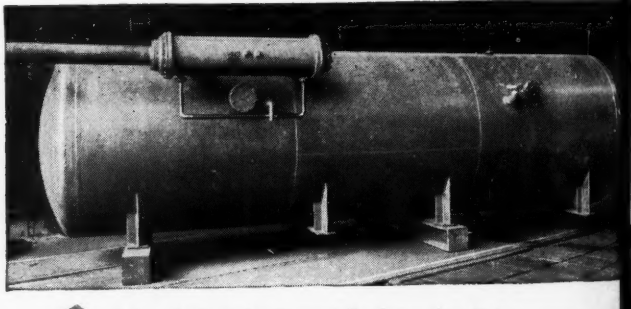
SEPT. 1944

Elliott

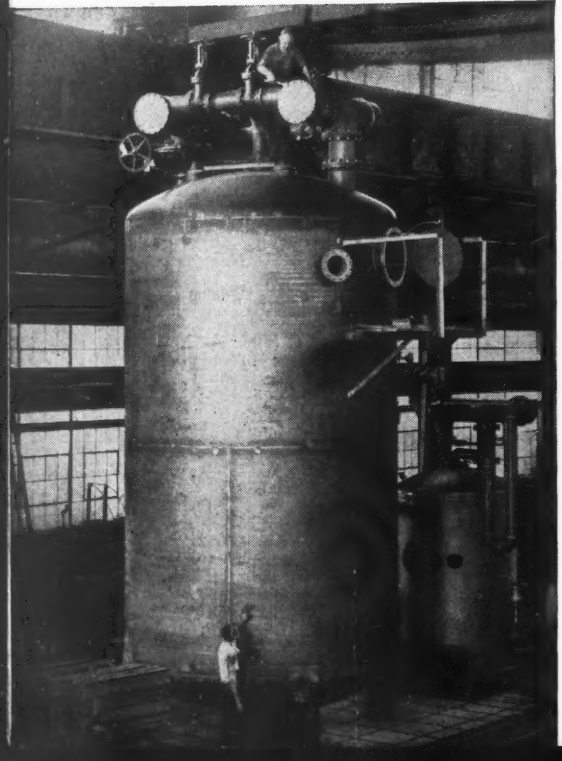
This Elliott deaerating heater was built in sections instead of with the shell in one piece so that it would go through the only available opening (a window frame) in the power plant in which it was to be installed.

Typical medium-size vertical deaerating heater mounted on a horizontal storage tank. Vent condenser on side to save headroom.

Standard horizontal deaerating heaters with special arrangement of vent condensers to cut down headroom.

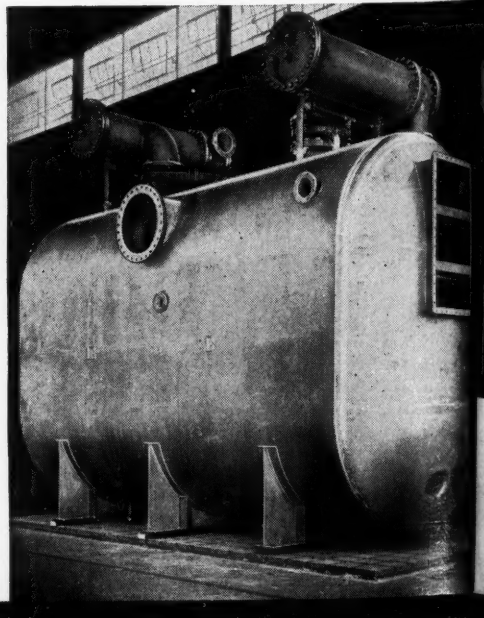


A long horizontal unit especially designed to fit into appropriate space aboard a wartime floating power plant.



This 1,500,000-lb.-per-hr. deaerating heater was shaped to fit into limited width in a big utility station.

Two vertical deaerating heaters. Unit at left has twice the capacity of the one on the right, and eight times the storage capacity. It is about as big as can be placed in a railroad car — 12 ft. by 27 ft. high.



Deaerating Heaters-

custom-built for the job!

Elliott engineers excel in designing deaerating units to fit constricted space or installation conditions, and still perform with Elliott high standard efficiency. The desired amount of storage may mean a large single-shell unit, or a deaerating heater with a separate storage tank. Space limitations and available access to buildings must be given first consideration. Railroad clearances limit the size and shape of large units. And with each variation in shape, the critical design areas, volumes, tray and water distribution, piping arrangements, and controls must be proportioned for dependable operation and maximum feedwater heating and deaerating performance.

To assure this kind of performance, practically every deaerating heater must be considered as a special job. How well Elliott engineers meet this requirement is shown by the photos on these pages.

If you have a heater problem, particularly one of unusual character, talk it over with these Elliott specialists.

ELLIOTT COMPANY

Deaerator & Heater Division, **JEANNETTE, PA.**

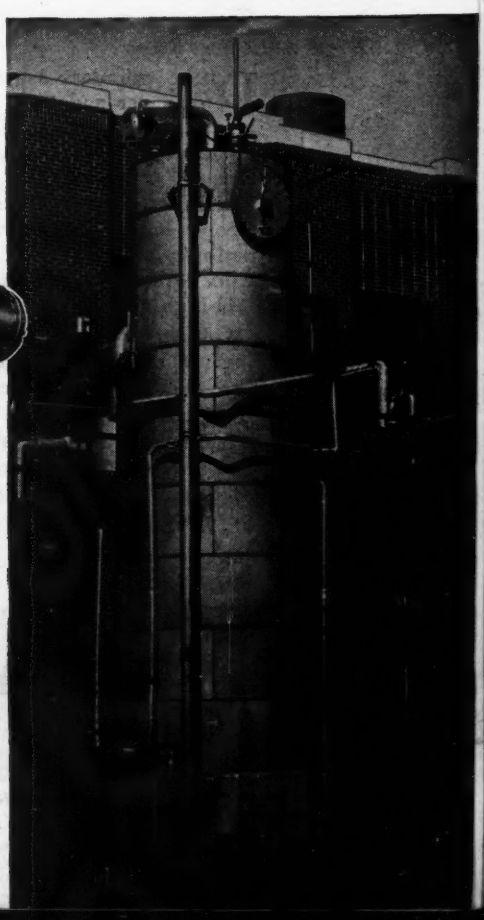
DISTRICT OFFICES IN PRINCIPAL CITIES

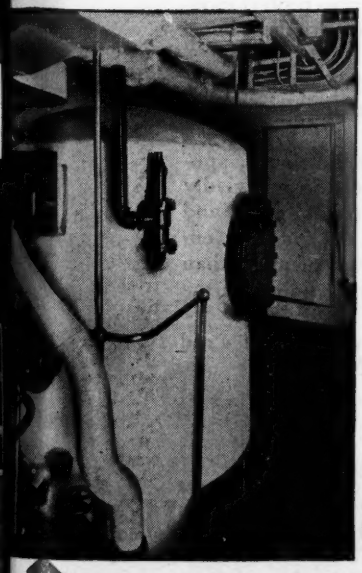
N-978

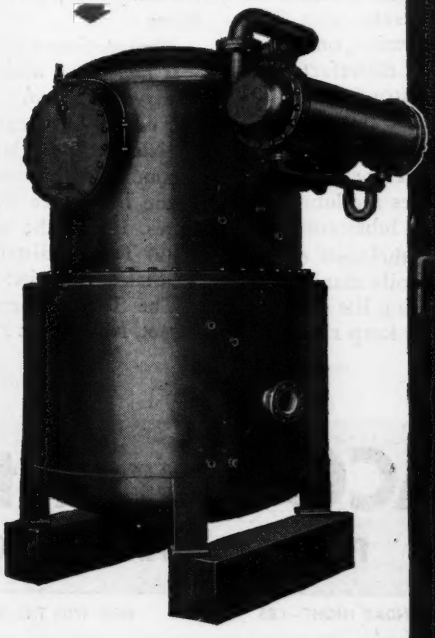
A star has been added to the Army-Navy "E" flags flown by both the Jeannette and the Ridgway plants of Elliott Company.

For outdoor installation, this Elliott deaerating heater was made to accommodate large water storage underneath the deaerating heater proper.

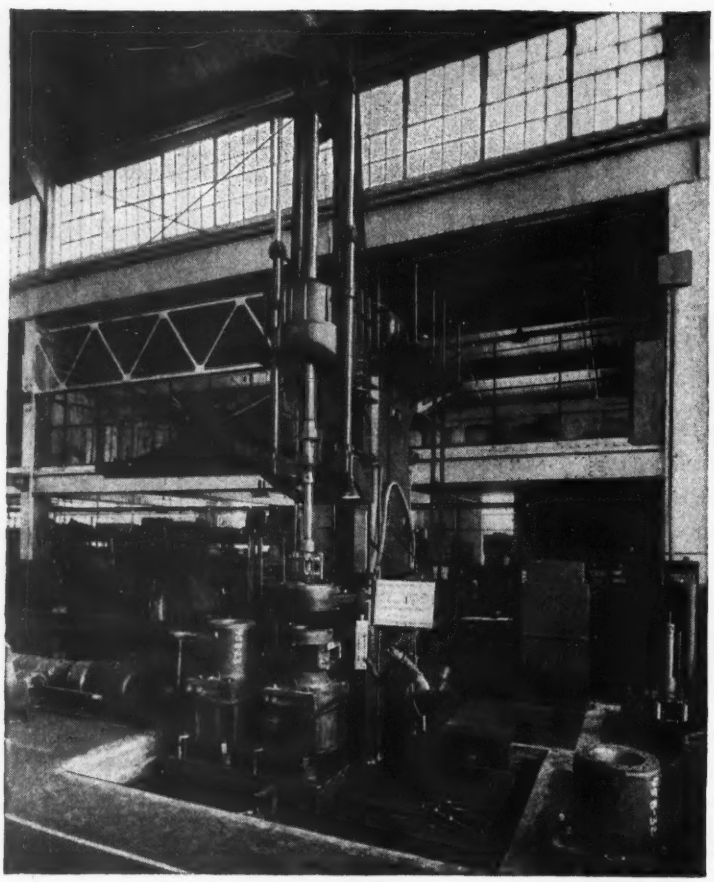
Low headroom deaerating heater, for installation in limited space in existing building, constructed so that lower part of unit could be put in place and the upper part slid over it. Vent condenser mounted on side.







Deaerating heaters for installation on board ship are built with the utmost compactness, usually with internal vent condensers, as illustrated.



Honing BIG Diesels

DIESEL cylinders as large as 26" in diameter and 7' 4" long can now be given the truer surfaces and the closer tolerances possible only with honing. One of the first to apply this method of finishing to BIG Diesels was The Cooper-Bessemer Corporation, one of the nation's leading Diesel manufacturers, who designed and constructed the 20-foot-high honing machine pictured.

On Diesels large or small, finer finishing means more efficient operation . . . particularly when engines are lubricated with Texaco Ursa Diesel lubricants.

Texaco Ursa Diesel lubricants constitute a complete line of oils that prevent scuffing, thereby increasing life of rings, pistons and liners. They keep rings free in their grooves, valves active, ports clear, assuring full piston seal that means maximum economy, and longer periods between overhauls. They also protect modern alloy bearings. Because of these benefits—

More stationary Diesel hp. in the U. S. is lubricated with Texaco than with any other brand.

A Texaco Lubrication Engineer, specializing in Diesel lubrication, will gladly recommend the most suitable type and grade of *Texaco Ursa Oil* for your engines. Phone the nearest of more than 2300 Texaco distributing points in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO Lubricants and Fuels

FOR ALL DIESEL ENGINES

TUNE IN THE TEXACO STAR THEATRE EVERY SUNDAY NIGHT—CBS ★ HELP WIN THE WAR BY RETURNING EMPTY DRUMS PROMPTLY

POWER PLANT ENGINEERING

Contents, September, 1944

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Cover: Systematically designed boiler room control panel for a utility power plant. Photo, courtesy, Leeds & Northrup Co.

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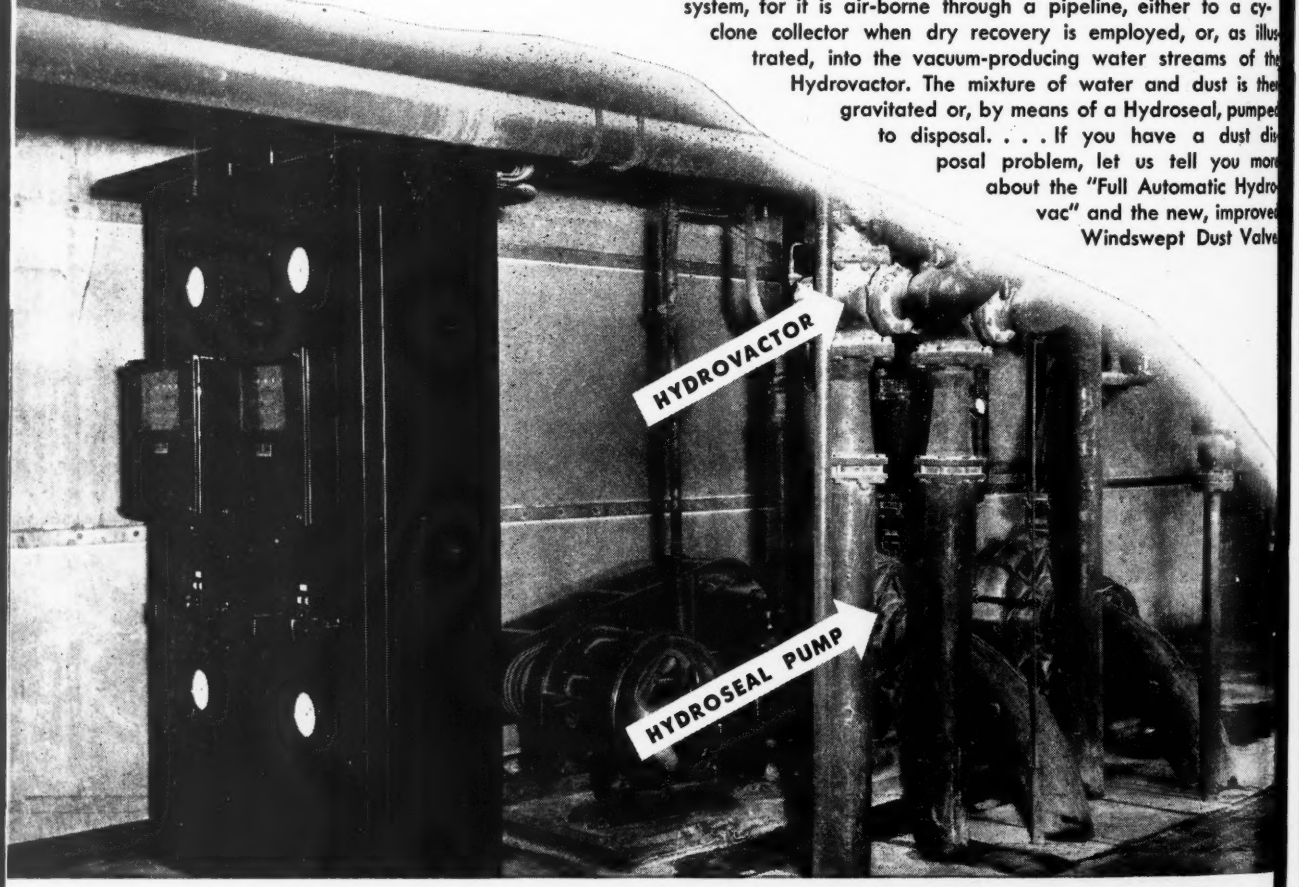
SEE ASH FOR ASH and DUST HANDLING

DUST HANDLING
"Licked with One Hand"

With the "Full Automatic" Hydrovac Dust Handling System, the mere throwing of a switch (a one-handed job), on the remote control operating panel, starts the removal of dust from various hoppers throughout the plant. One Windswept Dust Valve after another opens, feeds dust and closes, and when the last hopper is clean, the system automatically shuts down. Signal lights on the control panel show which hopper is being emptied of dust. . . . No labor for attendance is required. Dust cannot escape from the system, for it is air-borne through a pipeline, either to a cyclone collector when dry recovery is employed, or, as illustrated, into the vacuum-producing water streams of the Hydrovactor. The mixture of water and dust is then gravitated or, by means of a Hydroseal, pumped to disposal. . . . If you have a dust disposal problem, let us tell you more about the "Full Automatic Hydrovac" and the new, improved Windswept Dust Valve.



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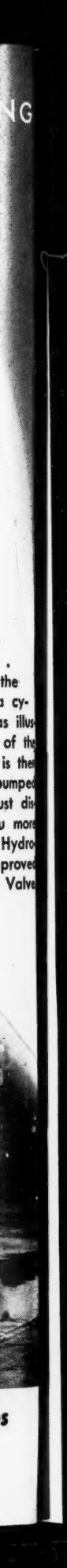


FRONT LINES

HERE ARE two letters commenting on the item about the Westinghouse research on clothes washing in July Front Lines, page 7, column 2, last paragraph.

Dear Sir: I was quite interested in the comment in Front Lines, July issue, regarding laundering. I will pass up the first part of the first sentence. If you had 1000 dirty laundry bundles to process per day in a plant designed to process 500, and with incompetent or sufficient help—you would find no humor in the situation.

However, regarding the scientific phases of washing, I am unfamiliar with the problems confronting the exponents of home washing, or how much dirt is left in clothes washed in household washers. I do know that many power laundries use certain scientific methods in controlling the washing process. For example, in our own plant we are very careful in the matter of pH control, in the strength of bleach used and temperature involved. Most laundry supply houses of any size maintain laboratories which are constantly at work, experimenting and working to find new or better products to wash with. From the use of numerous test pieces washed with the regular loads, we are able to find conclusively the whiteness retention and tensile strength losses suffered by these pieces. This information helps us to better our washing formulas.

I'll grant that the housewife in washing probably uses only three rinses, included in which is the blue. We use, in our process, six rinses plus the blue plus the sour operation, a total of eight rinses. By using this many rinses we are enabled to bring the alkalinity of the clothes to that of the tap water. Below that we cannot go, so we use the sour to neutralize any water alkalinity thus giving the final operation a pH of 5, which is the ideal pH for the ironing process.

Of course, fabrics absorb a certain amount of soap and alkali. No amount of rinsing will entirely remove this absorbed soap, at least with our present soaps. So we stop rinsing when the rinse water has the same pH as the tap water and use the sour to neutralize the absorbed soap and alkali and bring the pH to where we want it.

So, Mr. Editor, when you talk about lack of science in washing, please leave out the power laundries. We are using science to a considerable degree, even if we don't have sufficient help to get your shirts back on time.

Artesia Laundry & Cleaners,
Artesia, N. M. R. F. McQUAY

In reply, we pointed out to Mr. McQuay that it was not *we* who found humor in the laundries' troubles, but the radio comedians, who often reflect popular thinking. We are glad to note that that particular brand of corn is now off the market. Here is an extract from his second letter:

. . . . Too many people are unacquainted with modern laundry methods and think that the process is conducted by rule-of-thumb methods. Of course, in a good many plants—too many—this is true. However, in our plant, we feel that scientific methods pay off, both in customer satisfaction and in time, labor and supplies saved.

Incidentally, while I have not been a subscriber to Power Plant Engineering very long, I have gotten several ideas from it which have been quite helpful in our plant here. It has been my experience that even though the set-up described may be a large installation, the feature desired may be adapted to a small plant. So the fellows who are crying for articles on small plants have nothing to argue for. If they need an idea they can find it in a large installation—if they want to.—R. F. McQUAY.

Thanks for the plug, Mr. McQuay. We'll do our best to keep you feeling that way. With that progressive attitude, both you and your company should go far.

A PLAN to Help You Employ Disabled Veterans and Other Handicapped Persons Productively and Safely is the title of a new booklet now being distributed by American Mutual Alliance, 919 N. Michigan Ave., Chicago 11, Ill. The booklet discusses in detail five steps in the plan. They are: 1, Learn the medical facts; 2, analyze your jobs; 3, match the man and the job; 4, introduce the man to the job; 5, plan for follow-up.

AFTER MORE THAN two years of study, conferences, and investigation, the stoker manufacturing industry, through its national organization, the Stoker Manufacturers' Association, has established standard codes for the determination of rated capacities of both bituminous and anthracite underfeed stokers. These codes provide a uniform method for the testing and rating of underfeed stoker equipment up to 1200 lb of coal per hr capacity and were unanimously approved and adopted at the recent annual meeting and war conference.

ENGINEERS and management executives, by and large, are of the middle class. They are not capital, they are not labor, yet they are both. Engineers and industrial management men had better give considerable thought to the future of the middle classes. In this process, they will do well to consult a recent book called The Rest of Your Life, by Leo M. Cherne, Editor-in-Chief of the Research Institute of America. In our opinion it is "must" reading for every engineer, whose future will be shaped less by what he does than by what big business on the one hand, and labor, on the other, achieve. Mr. Cherne discusses the principal forces, now operating, that have already produced the conditions that will determine how they will spend the rest of their lives. Everything he says is based on two postulates: 1, that the war has solved none of the fundamental problems that brought it about; 2, that there is a growing gap between our attitudes and our actions. He says the middle class has many segments, has varied and contradictory interests, no single purpose, no program. It asserts little business is the country's backbone, yet supports action to stifle its growth. Middle class men do not want to believe that big business wins over small business because of factors beyond the control of either. They have been changing from the old type of small owner to a new type of supervisory employee and they are badly confused, because they profess belief in a system of "free enterprise" that plainly does not exist any more. In the disillusionment after the war, they will have a well-baited Fascist hook hung in front of them all the time. Many will swallow the bait. How serious the consequences will then be, says Mr. Cherne, depends primarily on whether America achieves a high level of employment and prosperity or stumbles into depression after the war.

MICROPOROUS, wafer-thin rubber is now replacing wood in the manufacture of storage batteries. Its use as a plate separator makes possible for the first time the shipment of these batteries to all battle-fronts in a fully charged condition but without the acid and water heretofore necessary to insure the electrical charge as well as the life of the battery. This material, developed by scientists of the United States Rubber Co., has millions of tiny cells per square inch. Unlike wood it will not buckle if the protecting acid and water mixture becomes low or is completely expended. The use of this material permits complete charging of the unit at the point of manufacture, plus shipment minus the liquid. Another U. S. Rubber product designed to solve several major problems which have faced the aircraft industry in combat planes is a new glass, flameproof, synthetic rubber coated cloth.

THE POMPOSITY OF SESQUIPEDALIAN VERBIAGE was never better illustrated than in the signs we saw hanging in many New York store windows and doorways last June: "Illumination is required to be extinguished before these premises are closed to business." That's the sort of thing Maury Maverick railed against, calling it "gobbledygook language." Mr. Maverick cited the following block-busters from a committee chairman's speech:—"maladjustments coextensive with problem areas" . . . . "utilization of factors which in a dynamic democracy can be channelized in both qualitative and quantitative phases . . . ." and so on and on. Mr. Maverick blew up. He issued a manifesto condemning such stuff as gobbledygookery of the first water, full of sound and fury, signifying nothing. Then the erudite John Kieran, in his column One Small Voice in the New York Sun, took a hand. He praised Mr. Maverick's attack on those who "have been at a great feast of language and stolen the scraps." But he also admonished Mr. Maverick gently for his assertion that gobbledygookers were "dragging in the corpses of dead languages," pointing out that many of Mr. Maverick's very words of rage and protest were themselves the corpses of the dead Greek and Latin languages. And so the merry rhetorical carnage went on, to the vast amusement of those of New York's inhabitants who read other than the sports pages and the racing forms. We hope it has brought those signs down at last. "Illumination is required to be extinguished . . . . " PHOOEY!!!

T-DAY for various industries may be approaching rapidly, if the present war news is any indication. T-Day is the day on which your war contract terminates. Whether you believe the present governmental preparations for contract termination are right or not, you'll have to admit that at least some attempt is being made to prepare for it. That's so much better than we did at the end of World War I that we ought to give our country a little credit for it and not keep insisting that it's all no good just because some detail doesn't suit us. In any event, the Research Institute of America, 271 Madison Avenue, New York 17, has made one of the most important contributions to the orderly termination of war contracts in its recent Analysis No. 33, Contract Termination, a Guide for Prime and Sub-contractors. This 100 page book, published for its clients, reviews every detail of contract termination procedure with observations and recommendations on what you can do right now to prepare for T-Day and what you will probably have to do then. The entire discussion is practical, deals with realities, not prejudices, and includes a large wall chart summarizing the entire situation. This is the only treatment of the subject we have seen that translates the legal "verbifuge" into terms of "here's what you ought to do."

ROBIN HOOD would chuckle with satisfaction to know that the old cross-bow is being used to produce super-fine quartz filaments employed in science's most modern aid, the electron microscope. The bow is made of steel and is mounted solidly. To the rear of the arrow is attached a small cylinder of quartz which is heated by a torch until just ready to melt. At this instant, the arrow is released, trailing a fine filament of quartz 1/60 the thickness of human hair, reports Ohmite News.

FIRST COMMERCIAL production of Silicones, new organo-silicon polymers, has been announced by Dow Corning Corp. of Midland, Mich. In the course of the Corning investigations, water white liquid polymeric silicones were discovered having unusual chemical and physical properties. These materials, now available under the name of Dow Corning Fluids, are manufactured in various viscosities ranging from liquids as thin as water to those which barely flow at room temperature. Their most outstanding property is an exceptionally low rate of viscosity change with temperature, compared to that of previously used liquids. Certain types are made that do not freeze at dry ice temperatures and these same products can be used at temperatures up to 400-500 F. Obviously the exact purposes for which these materials have been developed cannot be discussed at this time. However, they are now in quantity production and samples, together with detailed information on their properties, can be obtained from the manufacturer. Among the other products that stemmed from Corning research are electrical insulating varnishes and resins. Silicone resins for electrical insulation extend the range of operating temperatures possible in electrical equipment beyond the limit of thermal stability of conventional organic materials. One is available as a coating and impregnating varnish which may be applied to Fiberglas cloth, asbestos cloth, asbestos paper and Fiberglas served wire or the like by conventional dipping and drying methods. It requires baking at a temperature of 250 C for one to three hours, to cure to a non-tacky state. Another is an impregnating varnish which sets with heat at 200 C.

'JEVER hear fish talk? Whadda ya mean they can't? Ever watch two goldfish in a bowl swimming around and suddenly gliding up to each other face to face and moving their mouths as if they were talking? Some fish actually appear to be kissing amorously. Or what about that one looking out at you through the glass and working his mouth just like that kid down the street who has adenoids? Well, maybe those fish are talking. Certainly they make sounds. Did you know they grind their teeth? All these sounds, many of which might be talk, can be diagrammed as vibrations on a screen, just like human or any other sounds, by means of electron-tube equipment. Dr. Christopher Coates of the New York Zoological Society Aquarium has classified fish sounds and shows some curves of them and photos of the fish that made them on page 115 of the August issue of Electronics. He has recorded grunts by a displeased box fish, purring from a contented catfish. Well, we are not surprised. We remember how the hornpout (similar to the Middle Western bull-head) used to snarl and grunt and squeak asthmatically when we hauled them out of the lakes in New England.

NO ROSY PICTURE this (as Time would Homerize it) of the way in which management has interpreted industry to the ordinary working man and woman. The contrast between what workers *really* think about capital-labor relations, wages, prices, profits, foremen, working conditions and what management *thinks* they think, is appalling. If you don't want to take our word for it, read the words of a man whose business it is to find out what working people think. He is Everett R. Smith, research director for MacFadden Publications and in a splendid article, What Your Workers Really Think, in the July, 1944 issue of Industrial Marketing he tells how he finds out and what the results are. You'll be shocked, we hope, into doing something about it.

SAVE... WITH MAXIM HEAT-RECOVERY SILENCERS ...FUEL

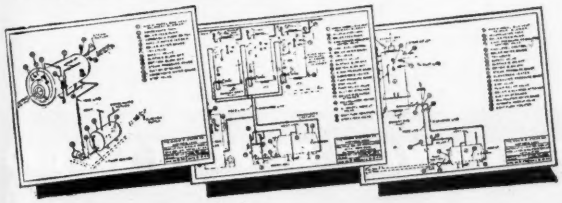
The source of heat used by Maxim Heat Recovery Silencers is engine exhaust heat, normally wasted. From this heat and hence without the use of any additional fuel, steam or hot water for heating or processing operations is developed in practical usable volume. In addition, effective silencing of exhaust noise is accomplished (with or without the spark arrestor feature).

From an efficiency point of view the use of Maxim Heat Recovery Silencers is good practice at any time. From a national fuel conservation point of view their use is more than ever indicated today.

★ ★ ★ ★ ★ ★ ★ ★ ★

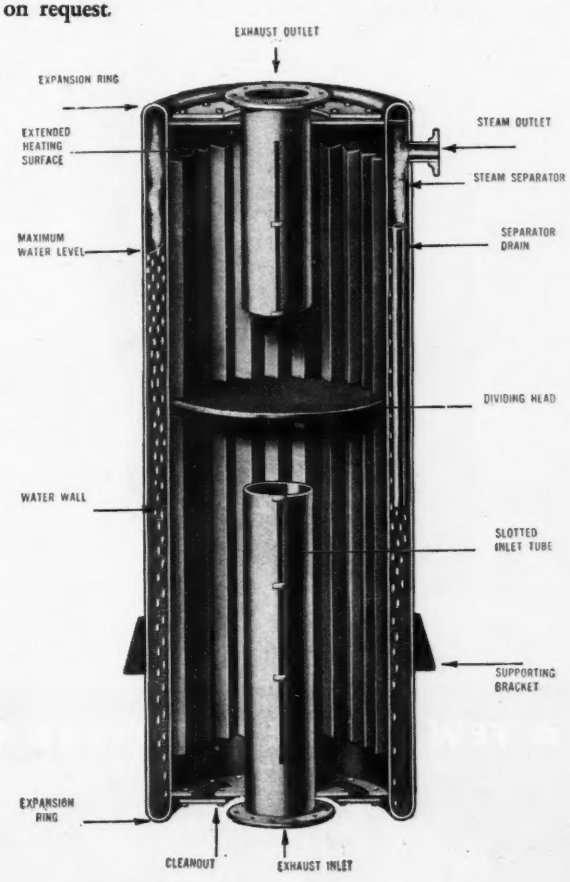
Maxim Silencers without the heat recovery feature are available for effective silencing of internal combustion engine exhaust or intake, steam engine exhaust, air compressor intake, vacuum pump discharge, blower intake and discharge. Engine exhaust silencers available with or without spark arrestor. Bulletins on request.

TYPICAL HOOK-UPS



The Maxim Engineering Department has prepared several drawings of typical Heat Recovery Silencer hook-ups. These are available with a detailed discussion of each hook-up. We will be glad to send them to you. Simply ask for Dwgs. B-298, B-301, B-302 and B-303.

Why not present your specific problem to Maxim engineers? Descriptive Bulletins WH-100, WH-102 and WH-103 will be sent promptly on request.



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89 Homestead Ave., Hartford, Conn.

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MAXIM

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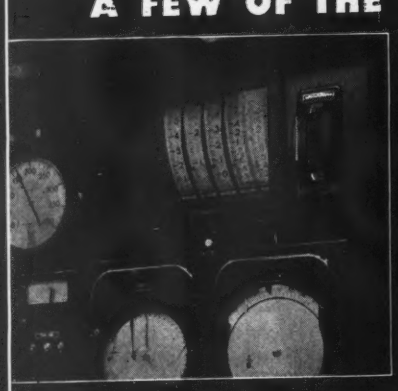
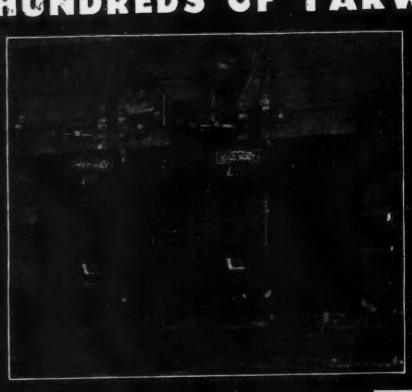
2

A FEW OF THE HUNDREDS OF YARWAY REMOTE LIQUID





YARWAY

Operated by the Boiler Water Itself

"POSITIVE AS THE LAW OF GRAVITY"

MORE accurate indication of boiler water or other liquid levels on instrument panel or other convenient location—a constant, positive check on remote, hard-to-see gages, right before your eyes.

That is what the *Yarway Remote Liquid Level Indicator* offers in a device so simple and operating on a principle so foolproof that it has been termed "Positive as the law of gravity."

Operated by the boiler water itself, this instrument literally "weighs" the difference between a constant column of water and the varying level in the boiler drum and indicates this difference, continually, by pointer movement over a calibrated scale.

That's all there is to it.

Extreme accuracy and instant indication are assured because the instrument is frictionless. There are no stuffing boxes. Operates by means of a unique, powerful, permanent magnet transmission between actuating mechanism, under pressure, and indicating mechanism, at atmosphere.

Hundreds of Yarway Remote Liquid Level Indicators in service throughout Industry and the Yarway Steam Laboratory's own accelerated endurance test (duplicating over 50 years of normal boiler service) have proved the dependability of this instrument beyond question.

Satisfied that it more than meets exacting Yarway Standards, this instrument is now offered to the general public. Look into this *moderately priced* instrument which is easily installed on new or existing boilers and is suitable for all pressures up to 1500 lbs.

Write for Bulletin WC-1820.

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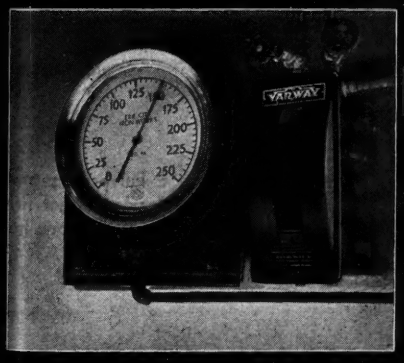
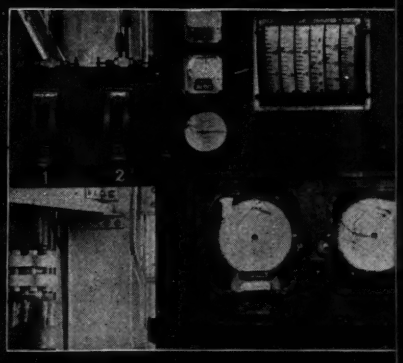
114 Mermaid Ave., Phila. 18, Pa.

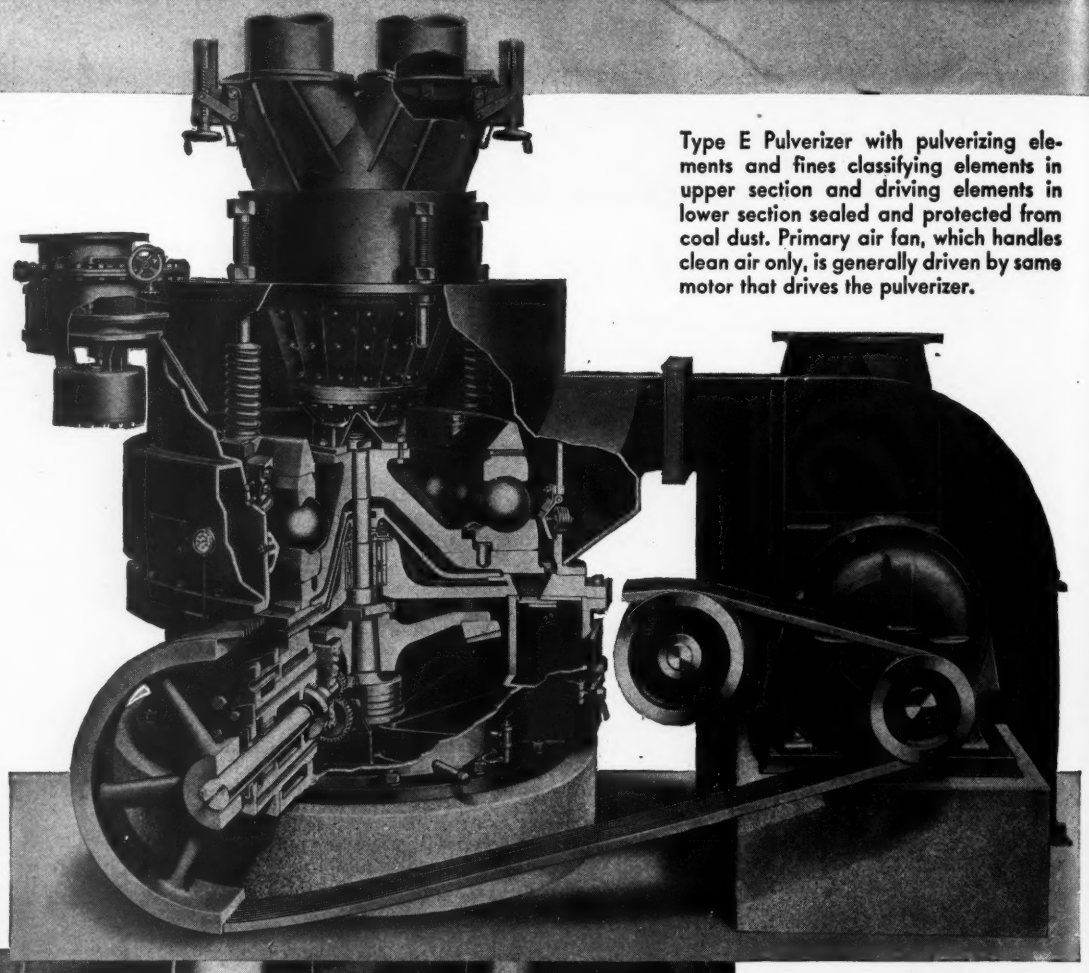
D LEVEL INDICATORS IN STATIONARY AND MARINE SERVICE



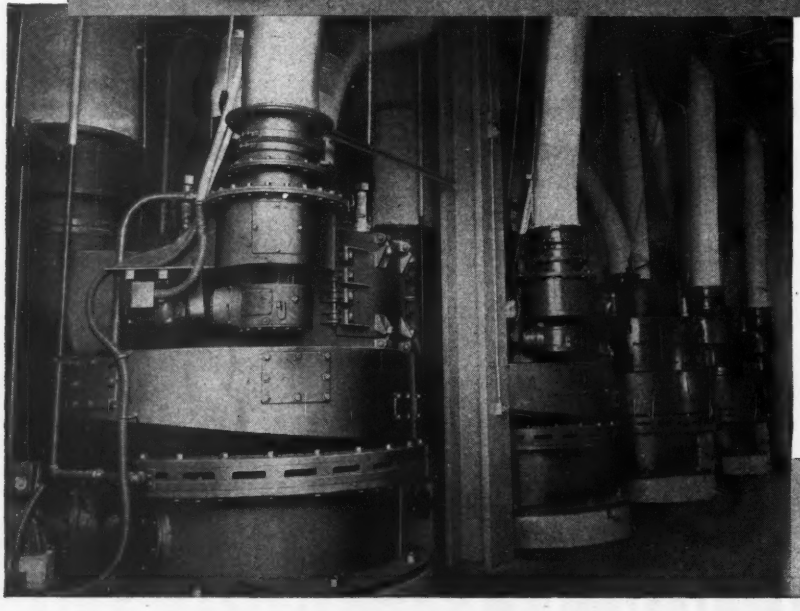


REMOTE LIQUID LEVEL INDICATOR

The B&W



Type E Pulverizer with pulverizing elements and fines classifying elements in upper section and driving elements in lower section sealed and protected from coal dust. Primary air fan, which handles clean air only, is generally driven by same motor that drives the pulverizer.



Over 400 Type E Pulverizers are in service or on order for direct firing boilers. Individual installations have as many as 16 units.

Type E Pulverizer

Fits into Any Day's Fuel Picture

Operates reliably and effectively in direct-firing pulverized-coal systems

By every standard of direct-firing pulverizer performance, the Type E Pulverizer fits into the fuel economy picture any day:

Type E Pulverizers—

Are reliable in service and low in maintenance, as measured in service hours before replacement of parts becomes necessary.

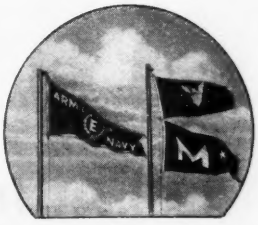
Respond readily to load changes—output controlled at one point, the primary air damper, and are adoptable to fully automatic control.

Maintain fineness and capacity throughout life of grinding elements.

Handle coal of a wide variety and, due to drying in the mill, can handle coal with as much surface moisture as it will carry.

These and other features of the Type E Pulverizer are given in more detail in Bulletin G-30-A. Copies obtainable on request.

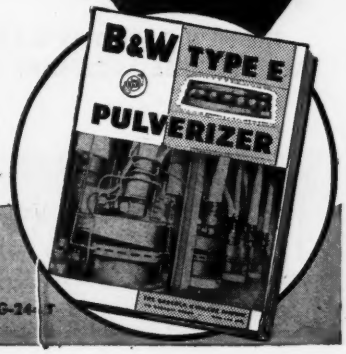
THE BABCOCK & WILCOX COMPANY
85 LIBERTY STREET, NEW YORK, N. Y.



The Army - Navy "E" and Maritime Commission Award flags are floated proudly at the plant that builds Type E Pulverizers.

Ball-bearing grinding element of the Type E Pulverizer. Simple – Sturdy – Efficient.

For a copy of this bulletin return this pasted on a penny post card with your name and address.



BABCOCK & WILCOX G-24-T

NEW GARGOYLE

SETS NEW

...for Turbine Oil Performance

WHAT MAKES A GREAT TURBINE OIL?

✓ ***Excellent Base Stock:*** The fundamental requirement for an ideal turbine oil is a base stock that in itself is an excellent turbine oil with excellent resistance to oxidation.

✓ ***Extra Resistance to Oxidation:*** Oxidation protection—PLUS—is needed to meet the effect of greatly increased temperatures in modern turbine operation. Your turbine oil should have this PLUS protection.

✓ ***Maximum Anti-Rust Qualities:*** The possibility of the presence of water demands that the oil should furnish maximum protection against corrosion. Your turbine oil should give this protection.

THE NEW GARGOYLE D.T.E. OIL 797 HAS ALL OF THESE NECESSARY CHARACTERISTICS

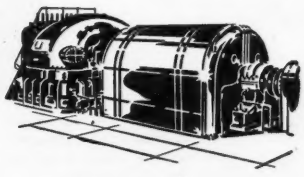
FROM THE WORLD'S LEADER IN LUBRICATION:

D.T.E. OIL RECORDS!

under Severe Operating Conditions

TODAY'S increased steam pressures and temperatures called for this great new turbine oil. So—here it is—the answer to the most severe turbine operating conditions.

Gargoyle D. T. E. Oil 797 has a base stock that is, in itself, an excellent, long-lasting turbine oil. To this superior base stock, we've added extra resistance to oxidation and rust.



The result is the ideal turbine oil, an oil that has already proved its superiority over all other turbine oils in severe tests, an oil that is already setting new standards of performance in all-size turbines.

Ask your Socony-Vacuum representative for full details ...for interesting performance figures. He'll be glad to give you all the details.

SOCONY-VACUUM OIL COMPANY, INC., Standard Oil of N. Y. Div.• White Star Div.• Lubrite Div.• Chicago Div.• White Eagle Div.• Wadhams Div.• Magnolia Petroleum Co.• General Petroleum Corporation of California

Socony-Vacuum Oil Company, Inc.

SOLVE YOUR SPEED REDUCTION PROBLEMS

with Westinghouse Gearmotors

80% of all motor-driven machines, 1 hp and above, must operate at slower speeds than the motors which drive them.

Consequently, some type of speed reduction must be inserted between the motor and the driven machine. The best method of accomplishing this is by the use of Westinghouse Gearmotors which are slow-speed drives with high-speed motor efficiencies.

The product of more than 50 years of gearing experience, these Westinghouse units are designed, built, tested and guaranteed as single units.

Ask your Westinghouse representative about this new, efficient gearmotor. Consult with him about your present speed reduction problems or postwar plans.

Type C — A double-reduction unit for standard ratios from 7.6:1 to 25.7:1, inclusive.

Write for new gearmotor handbook, "Gearmotor Applications". Ask for B-3218. Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., Dept. 7-N.

J-07217

First of a series sponsored by Westinghouse to promote the use of gearmotors.

The New Westinghouse

PLANTS IN 25 CITIES... OFFICES EVERYWHE

A GEARMOTOR IS THE MOST EFFICIENT MEANS OF SPEED REDUCTION

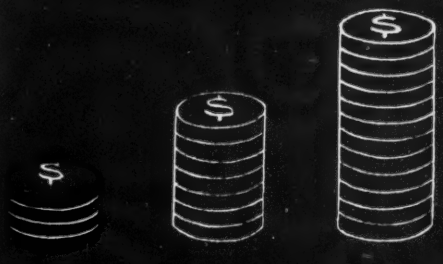
Because it offers:

1 **COMPACTNESS . . .** it takes less space than any other form of parallel shaft speed reduction . . . makes belts, belt guards, pulleys, overhead line shafts *unnecessary*.

2 **LONG LIFE—MINIMUM MAINTENANCE.** A gearmotor has no belts, chains or ropes to replace . . . no multiple-parts to realign . . . no bearings to oil . . . no gears to grease. Probable maintenance consists of a twice-a-year oil change.

3 **EASE OF INSTALLATION.** By combining the prime mover and speed reducer in a single unit, the gearmotor is installed quickly and inexpensively.

4 **HIGH EFFICIENCY.** Only 2% power loss is involved in each stage of reduction . . . a single-reduction unit is 98% efficient; a double-reduction unit is 96% efficient. Compare this with the efficiency of other types of slow-speed drives.



5 **LOW OVER-ALL COST.** The initial installed cost of a gearmotor is usually lower than any other type of speed reduction. On the basis of maintenance and power losses, a gearmotor is *always* most economical.

6 **SAFETY FOR WORKERS.** A gearmotor has no exposed moving parts... no belts, pulleys, chains or ropes to endanger workers. It is totally-enclosed in a streamlined housing.

Gearmotors

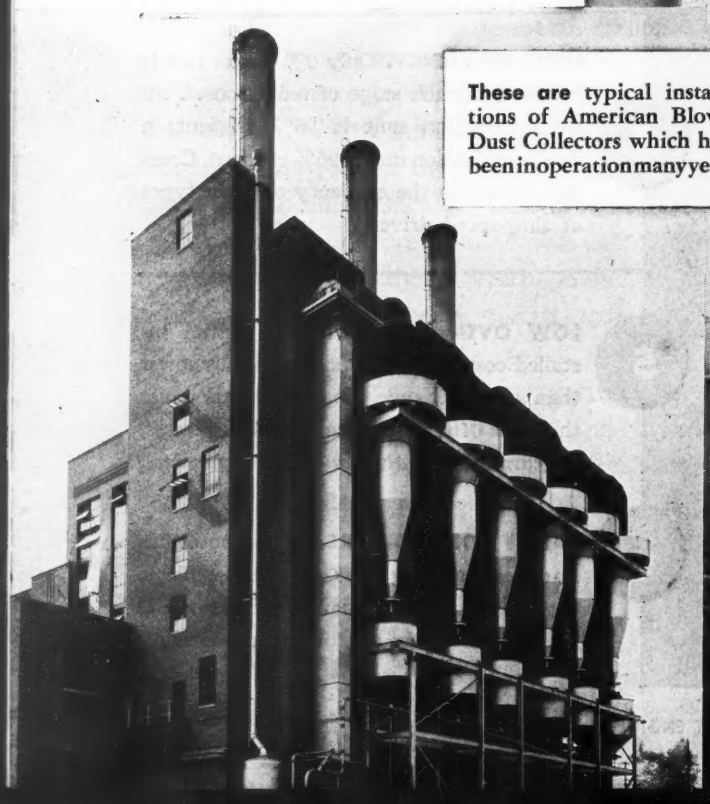
American Blower

A constantly increasing list of industrials has turned to American Blower to solve their dust problems. Many of these firms have been using American Blower equipment with highly satisfactory results for more than 20 years. Today, we are building dust collecting equipment for war industries of many types. Tomorrow, after Victory, our facilities will be available for all industries who recognize that dust collection is only sound business. If you have operations involving mining, brushing, drying, grinding, crushing, packing, dumping, conveying, spraying, cleaning, tumbling or rattling, or, if cinders, ash or fly-ash present a problem, contact our nearest branch office or write direct to the factory and we will keep you posted on progress on our Dust Collectors. Our engineering staff and laboratory facilities, the finest in the industry, are available to you for testing dust samples of all types.

AMERICAN BLOWER

AMERICAN BLOWER CORPORATION, DETROIT, MICH.
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONT.

Division of American Radiator & Standard Sanitary corporation



These are typical installations of American Blower Dust Collectors which have been in operation many years.

DUST COLLECTORS

Scene in the American Blower Dust Laboratories, where complete facilities and equipment are available to test every type and texture of dust.

Dust — the inevitable by-product of many industrial processes — can cause great losses or, in many instances, be utilized for important savings, depending on the way it is handled. It may also shorten the life of machinery and equipment by erosion. In some cases, it is a health hazard to employes and a nuisance to the public.

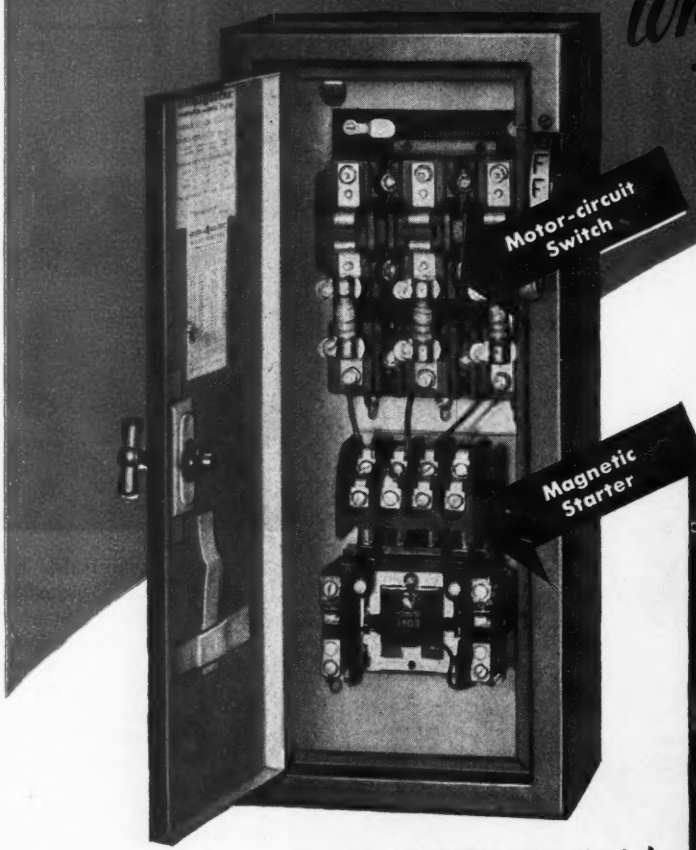
You can save time and space --

ONE COMPACT

Why two devices? ONE

GE

COMBINATION STARTER



Combination starter and push-button station on a press

G-E COMBINATION STARTERS AT WORK

-gain greater protection too

UNIT

FOR MOTOR CONTROL AND PROTECTION

can do the job.

YOU no longer need buy a separate device for each function of motor control. Now you can get *combination* control—in a *variety of enclosures* to meet every operating condition. This control combines a motor-circuit switch and a magnetic starter in one, compact, easy-to-mount unit.

By using these starters you profit five ways:

1. Quick Selection—By ordering *one* factory co-ordinated unit instead of two, you can save time. You just specify the motor rating and indicate the type of motor-circuit switch you want and the type of application you have in mind—we'll send you the starter you need.

2. Reduced Installation Time—Users of combination starters report a 50 per-cent reduction in mounting time and a 40 per-cent reduction in wiring time.

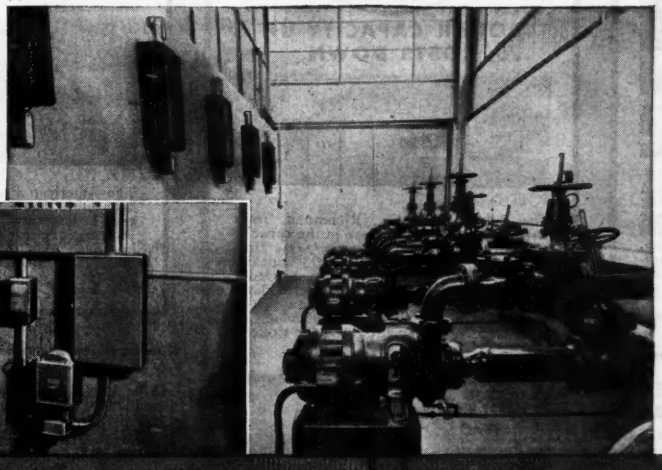
3. Motor Protection—With G-E combination starters, you're sure that the rating of the motor-circuit switch or breaker matches that of the magnetic starter with which it is to be used. The co-ordination of thermal overload relays with the fuses or breakers affords complete motor overcurrent protection under any condition of operation.

4. Greater Safety—The motor-circuit switch, being in the same case with the magnetic starter, is mechanically interlocked with the cover. Thus the cover cannot be opened while there is power on the starter.

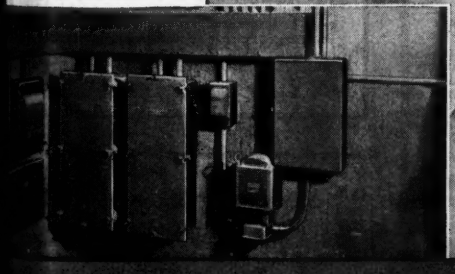
5. Less Space Required—Combination starters take less mounting space than separately mounted safety switches and starters.

These starters are also available for high-voltage starting. For further information on combination starters write to your local office for Bulletin GEA-3715. *General Electric Company, Schenectady 5, New York.*

Combination starters (on wall at left) installed in a pump room



For reliability of operation, combination starters with dust-tight enclosures in a grain elevator



Every week 192,000 G-E employees purchase more than a million dollars' worth of War Bonds

GENERAL ELECTRIC

IRON FIREMAN

Proved in these

COAL SAVED WITH ⅓ LOAD INCREASE

The F. B. Huxley & Son Company, Ontario, N. Y., largest eastern food dehydration plant installed a dual-nozzle Iron Fireman Pneumatic Spreader. Frank Vandewater, superintendent, says: "When we were hand-firing, 20 tons of coal a day were used. Now, we have increased our load ⅓, yet we use only 18⅓ tons per day."

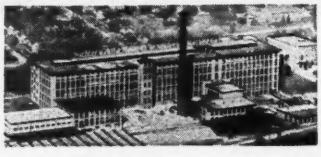
40,000 POUNDS OF STEAM PER HOUR

The Hartsville Print & Dye Works, Hartsville, S. C., installed these three Iron Fireman Pneumatic Spreader stokers to develop capacity to meet a maximum steam demand of 40,000 lbs. per hr. Fuel cost per thousand lbs. of steam has been reduced 21¼%. Total investment was liquidated in 12 months.

175% OF BOILER RATING

The Indianapolis Drop Forging Company, Indianapolis, Ind., whose purchasing agent, Fred Barnikol, says average savings with two Iron Fireman Pneumatic Spreader stokers run over $600 per month. Four 200 h.p. boilers are fired and carry a peak load of about 175% of rating, no small factor when wartime demands call for peak production.

STEAM COSTS CUT 32%

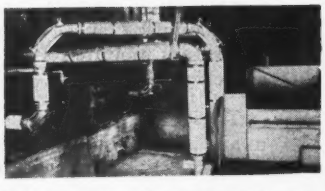


The Pacolet Mfg. Company plant, New Holland, Ga., where the installation of Iron Fireman Pneumatic Spreader stokers cut steam costs from $0.349 to $0.237 per thousand pounds, a reduction of 32%. Fuel savings amounted to $14,784 a year. Marshall C. Stone, vice president and general manager, says "The investment will be self-liquidating in a very short time."

79.6% BOILER EFFICIENCY

Wyndmoor Laboratory, U. S. Dept. of Agriculture, Wyndmoor, Pa., where official tests by the U. S. Bureau of Mines Fuel Economy Service showed the boiler efficiency to be 79.6%, approaching the maximum for simple boiler design without extended-heating surface. Three 2000 lb. per hr. Iron Fireman Pneumatic Spreader stokers produced this remarkable result.

GREATER LOAD—COAL SAVED



The Giant Grip Mfg. Co., Oshkosh, Wis., increased steam load 30% on existing boilers with this Iron Fireman Pneumatic Spreader stoker. Five steam hammers, that couldn't be used before for lack of steam, are now in full and efficient operation. Iron Fireman handles this greater load on one ton *less* of coal per day.

THE IRON FIREMAN

BOILER CAPACITY UP ... COSTS DOWN

The Belden Mfg. Co., Richmond, Ind., attained a required increase in the capacity of existing boilers and at the same time reduced operating cost by $3293 annually with Iron Fireman Pneumatic Spreader stoker firing. This company particularly appreciates the use of local and low-priced coal, handled with complete efficiency by Iron Fireman Pneumatic Spreader stokers.

PRODUCTION DOUBLED

The American Pad & Textile Co., Greenfield, Ohio, has had production doubled by war orders, and yet with Iron Fireman Pneumatic Spreader stoker firing, the plant has been able to operate with the same boilers as before, and *with no increase in fuel costs.*

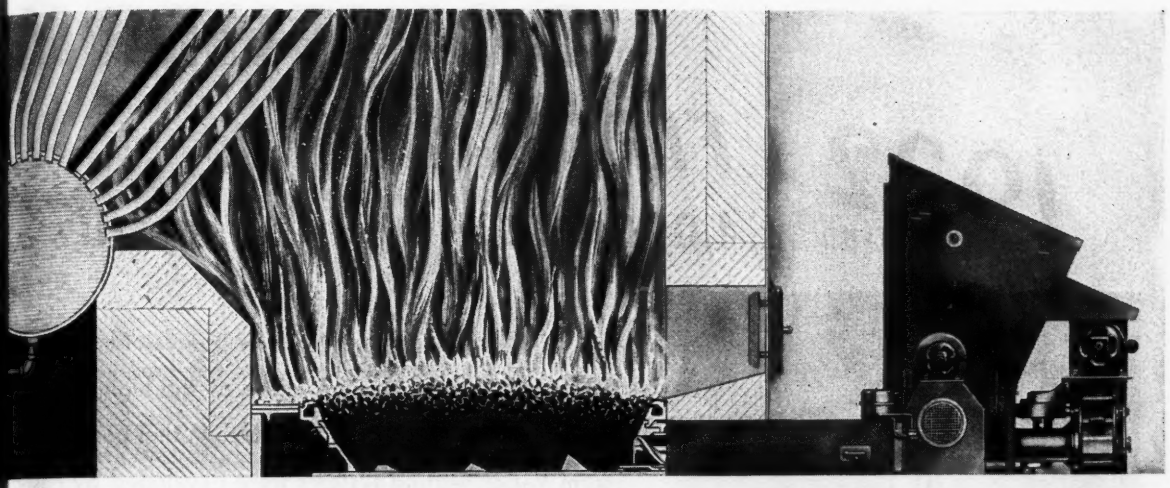
EXTREME LOAD FLUCTUATIONS HANDLED

St. Mary's Woolen Mfg. Co., St. Mary's, Ohio, found this Iron Fireman Pneumatic Spreader stoker installation the answer to great fluctuations in steam demands for processing. Phil Herzing, president, says: "We find that in spite of extreme peaks and subsequent rapid falling off, we can hold our steam pressure to within a variance of two pounds. We consider this superb performance."

OVER $12,000 SAVED ANNUALLY

The Halltown Paper Board Co., Halltown, W. Va., installed these Iron Fireman Pneumatic Spreader stokers because they burn lower-grade coals. Replacing multiple-retort underfeed stokers of another type, Iron Fireman stokers have brought this company remarkable fuel savings—over $12,000 a year. The savings have liquidated the investment in less than three years.

FUEL ECONOMY
typical boiler plants



The Iron Fireman Poweram stoker (one of the many industrial models built by Iron Fireman), is designed for heavy continuous loads. It combines *worm feed* with *ram distribution* of coal. The worm conveys the coal to the retort in a loose, aerated condition; reciprocating blocks distribute it evenly and prevent packing.

GOOD COMBUSTION AND AUTOMATIC CONTROL Produce These Achievements in Iron Fireman Firing

• Good combustion, resulting from Iron Fireman firing, means fullest use of the heat units in coal, with resultant savings in fuel and increase in steam output.

Iron Fireman automatic control assures firing that is continuously balanced to steam demands. It protects against excessive feeding that wastes fuel. It guarantees adequate fire for the existing load. And it saves manpower.

The ten examples shown here are typical of Iron Fireman firing achievements.

There is an Iron Fireman for Every Industrial Firing Need

Iron Fireman stokers are available in many sizes and models to meet the most varied industrial firing requirements. Iron Fireman engineering assures you the correct stokers for *your* plant, taking into account fuel, load and operating conditions. Our nationwide organization of qualified factory representatives is at your service. Write for literature. Iron Fireman Mfg. Co., 3294 West 106th St., Cleveland 11, Ohio. Plants at Portland, Oregon; Cleveland, Ohio; Toronto, Canada.

IRON FIREMAN
THE IRON FIREMAN
Automatic Coal Stokers

Blazing THE

DOWTHERM

1932 FIRST UNIT

4,000,000 Btu. per hr. capacity

Original Dowtherm Vaporizer installed in 1932 furnishes process heat for chemical production.

Foster Wheeler is a four star winner under the U. S. Navy Board of Awards for production.

● The development of new processes in the early 1930's emphasized the limitations of the high temperature heating methods then available. In that period Dowtherm Vapor heating systems were developed by Foster Wheeler. Utilizing the latent heat from condensing vapor, Dowtherm combines the constant temperature advantage of steam heating with high temperature processing at low pressure.

Precision control of product heating from 400 to 700 degrees F.; ability to maintain uniform surface temperatures; to supply heat at different and varying temperatures from one source of heat; to heat and cool in the same cycle . . . these characteristics of Dowtherm heating have gained the unqualified acceptance of Industry.

FOSTER WHEELER CORPORATION

FW FOSTER

ENGINEERING TRAIL

HEATING

1944 164TH UNIT

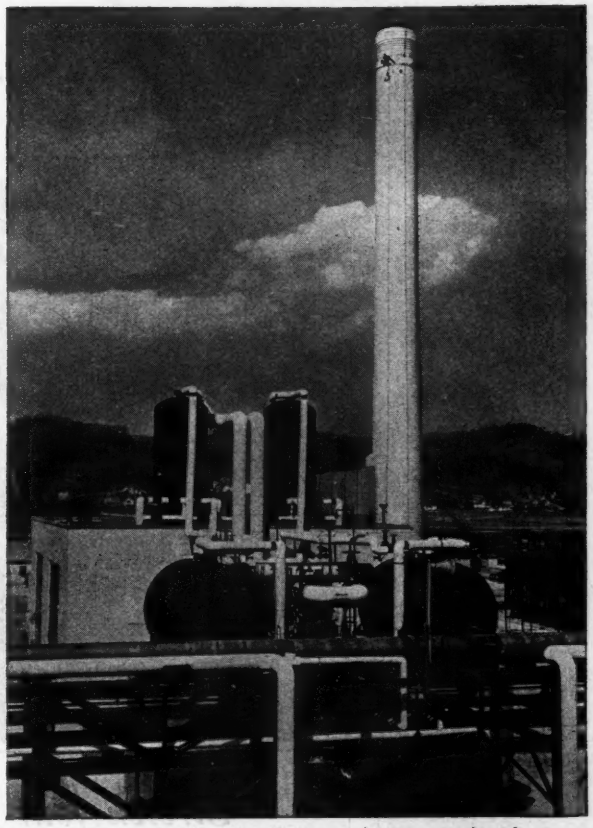
35,000,000 Btu. per hr. capacity

● Since the installation of the original Dowtherm Unit for a relatively simple high temperature chemical operation, the indirect heating system has been successfully adapted to a variety of processes in the chemical, petrochemical and petroleum industries. Among these applications are:

●

Synthetic Rubber Production
Edible Oil Deodorization
Bodying of Drying Oils
Synthetic Resin Production
Phthalic Anhydride Purification
Fatty Acid Distillation
Esterification
Fat Splitting
Special Petroleum Processing
Plastic Moulding and Manufacture
Asphalt Processing and Coating
Wire and Cable Manufacture

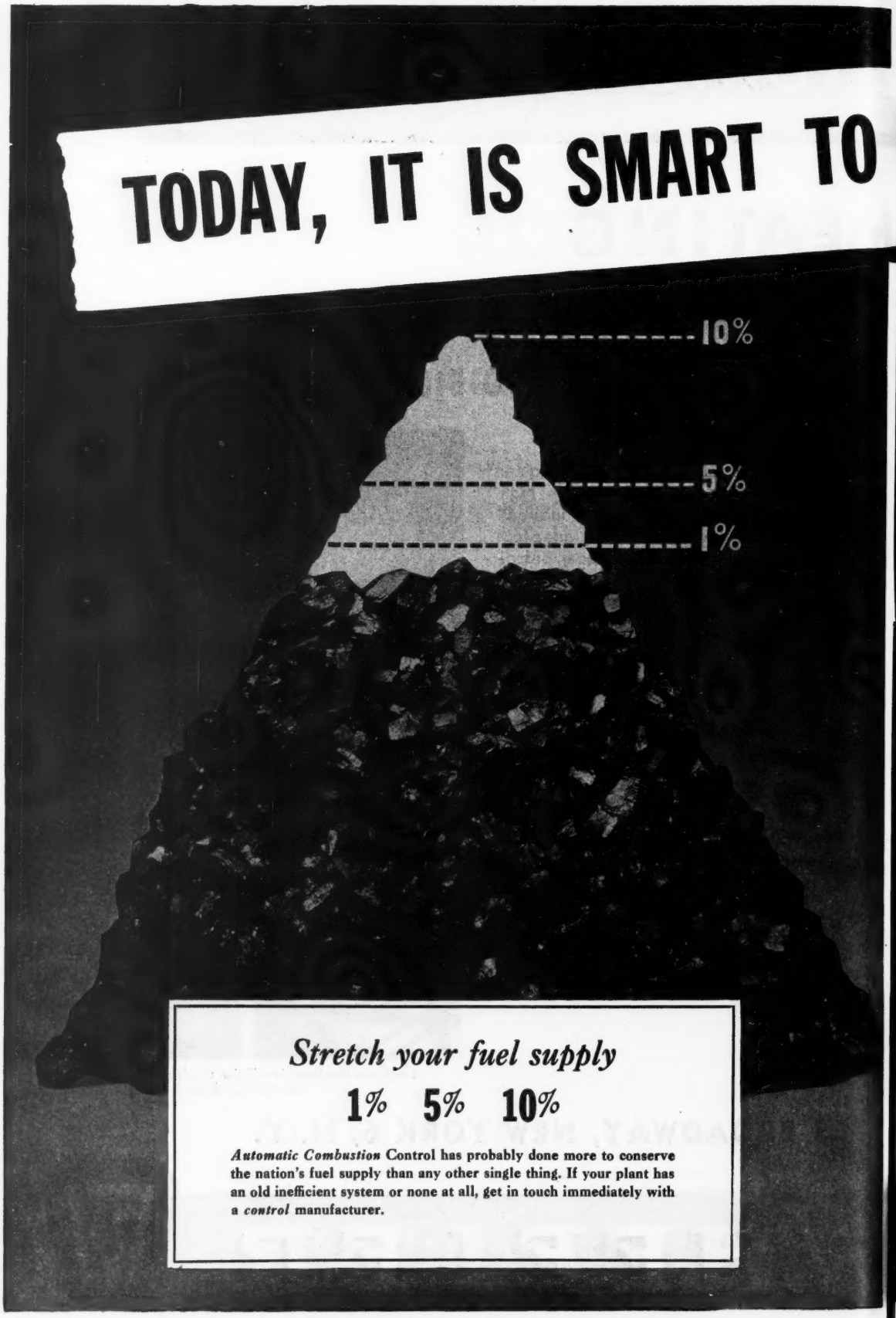
Further information on Dowtherm, including its use in Power Plants, is available in bulletin 1D-43-5.



Large new Dowtherm installation supplying process heat for butadiene production.

165 BROADWAY, NEW YORK 6, N. Y.

WHEELER


TODAY, IT IS SMART TO
10%
5%
1%
Stretch your fuel supply
1% 5% 10%
Automatic Combustion Control has probably done more to conserve the nation's fuel supply than any other single thing. If your plant has an old inefficient system or none at all, get in touch immediately with a control manufacturer.

BE A "COAL-MISER"

— especially when you can improve overall operating efficiency at the same time!

ENGINEERS in hundreds of America's leading power plants are thankful that they had the foresight to equip their boilers with Hagan Automatic Combustion Control.

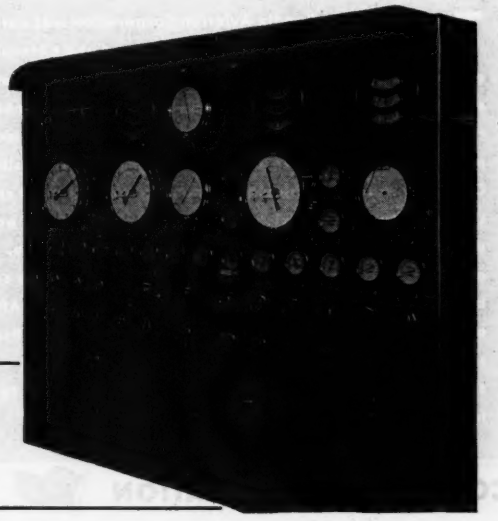
Today, coal has suddenly become a scarce commodity. Stretching what you have from 1 to 10 per cent through better combustion efficiency takes on special importance.

You *can* get such results, even though your firing equipment is *good*. Under less favorable conditions, a greater saving is not uncommon.

Reduced fuel consumption is just *one* of the many advantages offered by Hagan Control. Sound engineering and rugged construction make Hagan Control fast, accurate and dependable. How dependable is strikingly illustrated in a story just released by the War Shipping Administration.

An Africa-bound freighter had a 20 by 30-foot hole torn in her side by a torpedo. She was making tons of water, heeling over and settling down 12 feet by the head when the captain gave the "abandon ship" order . . . but that ship didn't sink! When engine department volunteers returned aboard they found that the plant was still seaworthy. The Hagan Automatic Combustion Control was still on and maintaining steam at the same pressure as before the "abandon ship" order was given. The freighter zigzagged to safety and continued on to port, 850 miles away!

Just those two factors — reduced fuel consumption—absolute dependability—are in themselves enough to warrant full inquiry. Shall we give you further information?



HAGAN
HALL
BUROMIN
CALGON

6.7% Coal Reduction per K.w.h. by this installation of Hagan Automatic Combustion Control in a medium-sized power plant.

HAGAN CORPORATION · HAGAN BUILDING · PITTSBURGH 30, PA.

HAGAN *Automatic* COMBUSTION CONTROL

The pioneer . . . and still the leader

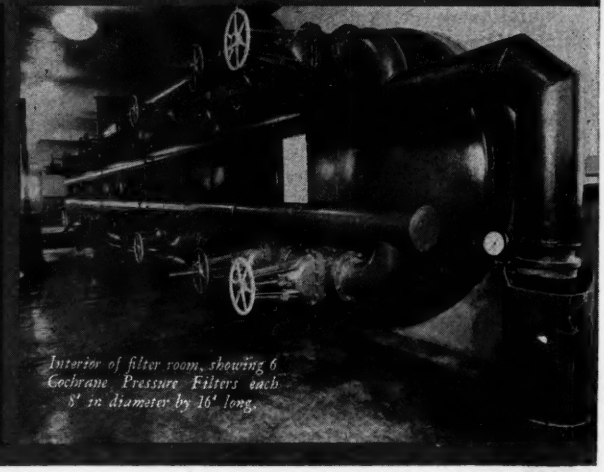
COCHRANE Water Conditioning at BENDIX

Removing Iron and Carbon Dioxide from Process Water Supply

Above are shown the Cochrane Decarbonators, each with a capacity of 2000 gals. per minute.

Cochrane Decarbonators are described and illustrated in Cochrane Publication 2975, a copy of which will be mailed on request . . .

THE war load on Bendix Aviation Corporation was naturally a very heavy one and involved rapid and extensive expansion of plant facilities. At the South Bend plant, water supply became a vital problem, which was solved by sinking two wells on the premises and installing the necessary pumps and pipelines. To insure the finest water possible, Cochrane water conditioning equipment was installed consisting of two rectangular Cochrane Decarbonators, each designed for a capacity of 2000 gallons per minute. By aeration, the iron is oxidized and precipitated and the carbon dioxide and some hydrogen sulphide removed. After aeration, the water is filtered through six Cochrane Pressure Filters, each 8' in diameter by 16' long, charged with sand and gravel. The installation is the largest of its type in the Midwest.

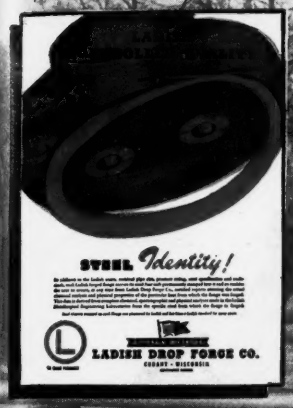


Interior of filter room, showing 6 Cochrane Pressure Filters each 8' in diameter by 16' long.

COCHRANE CORPORATION **3123 N. 17th ST., PHILADELPHIA 32, PA.**

COCHRANE

SOFTENERS • DEAERATING SOFTENERS • DEAERATORS • METERS • STEAM SPECIALTIES



On High Pressure Pipelines like this

LADISH *Controlled Quality* FORGED STEEL FLANGES ASSURE WELDABILITY

In producing forged steel flanges for all types of pipeline service, the rigid metallurgical control exercised by Ladish Drop Forge Co. assures that welding requirements will be met.

On installations like these, where varying conditions exist, Ladish green colored *Controlled Quality* Forged Steel Flanges can be depended upon for unfailing service.

Upon request, and by referring to the Ladish *heat code* permanently stamped on every flange, the user can obtain certified reports of the analyses of the steel from which the flange was forged.

Steel identity stamped on each flange was pioneered by Ladish and has been a Ladish standard for many years

TO MARK PROGRESS

ARMY E NAVY

FITTINGS DIVISION

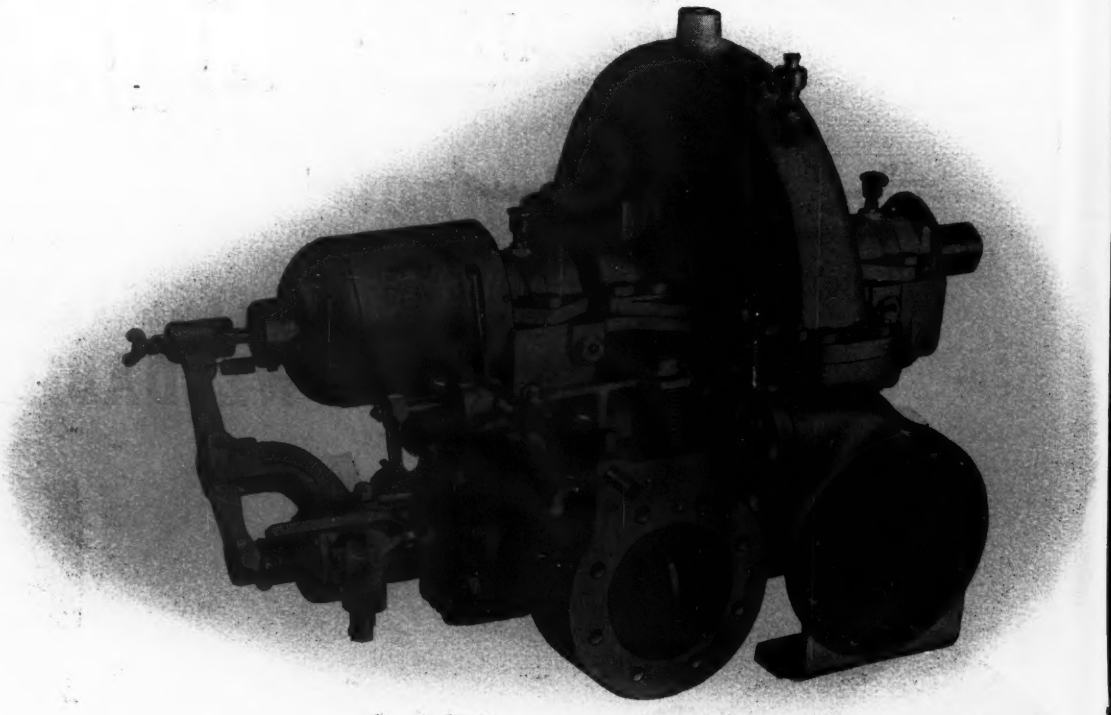
LADISH DROP FORGE CO.

CUDAHY • WISCONSIN

MILWAUKEE SUBURB

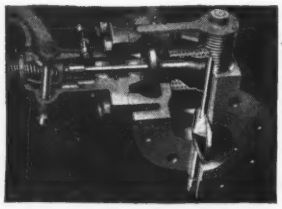
New York Office: 60 East 42nd Street, New York City

THE TURBINE WITH

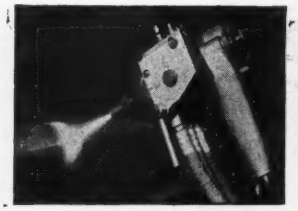


Steam turbines are expected to perform—and do, in all probability—for longer periods, with less attention than any other type of power drive. To meet these severe service demands, Westinghouse offers a complete line of Type C General Purpose Turbines with "built-in protection" against overspeed . . . steam leakage . . . explosion . . . unbalance.

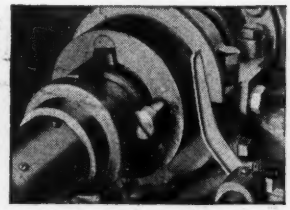
Built-in protection is typical of the plus features of Westinghouse General Purpose Turbines . . . features that result in extra reliability, extra safety, extra economy in operation. Competent engineering help in application problems and a nationwide maintenance service are as near as your telephone. Westinghouse Electric & Mfg. Co., Box 868, Pittsburgh 30, Pa.



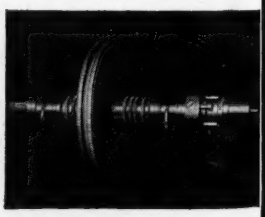
DUAL PROTECTION—During normal operation the turbine speed is controlled by the centrifugal-weight governor, or a regulator. If for any reason this control should fail, the overspeed trip device takes charge—simultaneously closing the butterfly valve and the governor valve when speed reaches 10 per cent above normal.



SHAFT PROTECTION—to prevent steam leakage and consequent oil contamination resulting from rust-cut carbon gland segments, shaft is sprayed with a generous thickness of high chrome-nickel steel at the two gland zones. Shaft is grooved, undercut and knurled to provide a permanent anchor for the sprayed metal. After spraying, entire shaft is finish-ground.



EXPLOSION PROTECTION—The only possible place a spark can occur in a turbine is on the overspeed trip lever. In applications where the turbine must operate in an explosive atmosphere, a sparkless overspeed trip lever with an insert of a special Westinghouse-developed plastic, Micarta, is used.

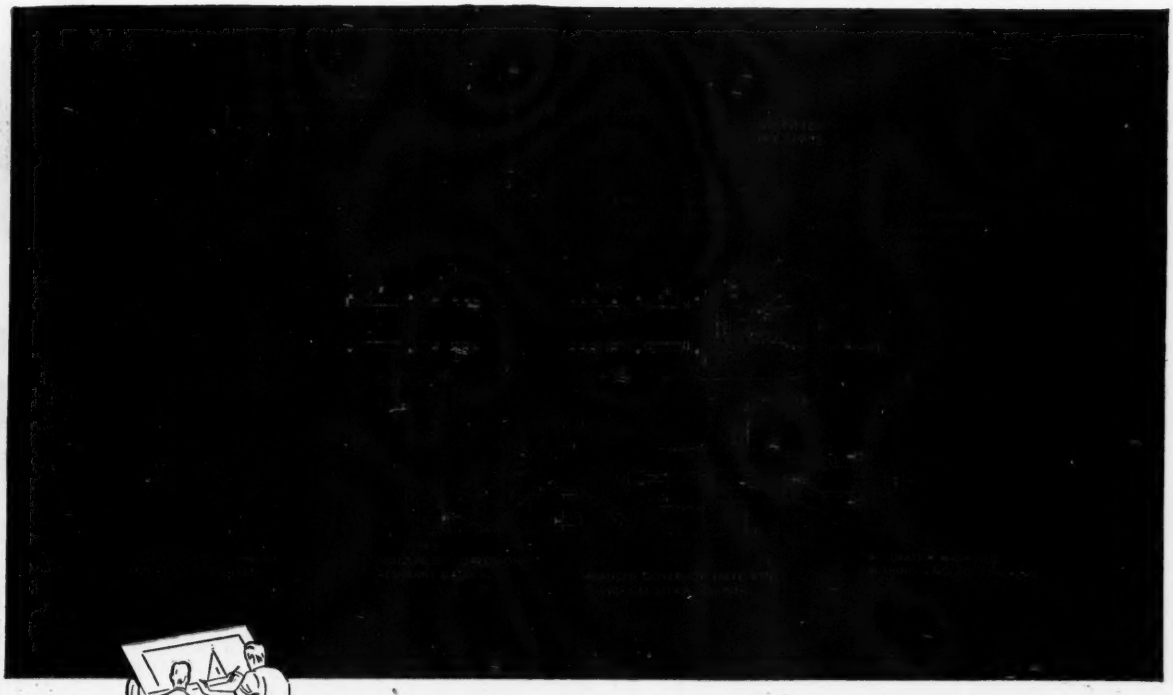


ROTOR PROTECTION—to sustain smooth operation, the rotor must preserve its original shape and dynamic balance in service. Placed in balance on the Westinghouse-developed Dynetric machine, the rotor is then coated with corrosion-resistant paint which insures maintenance of original shape and balance. Particularly important for stand-by or intermittent operation.

Westinghouse
PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Steam Headquarters

Built-in PROTECTION



DESIGN FEATURES

EASY TO INSPECT . . . by removing cover of horizontally split casing. All pipe connections are made to lower half of casing.

NO SOFT PACKING . . . for valve stems. Nickel-iron bushings have sufficient clearance for free movement of valve stems. Each stem has intermediate leak-off . . . minimizes leakage of steam into engine room. Governor valve and cage, butterfly valve and valve stems are highly resistant to corrosion and erosion.

CORROSION AND EROSION-RESISTANT NOZZLES . . . maintain proportions permanently. Passages are accurately drilled and reamed on a special machine that holds proportions precisely to design specifications—insures highest nozzle efficiency.

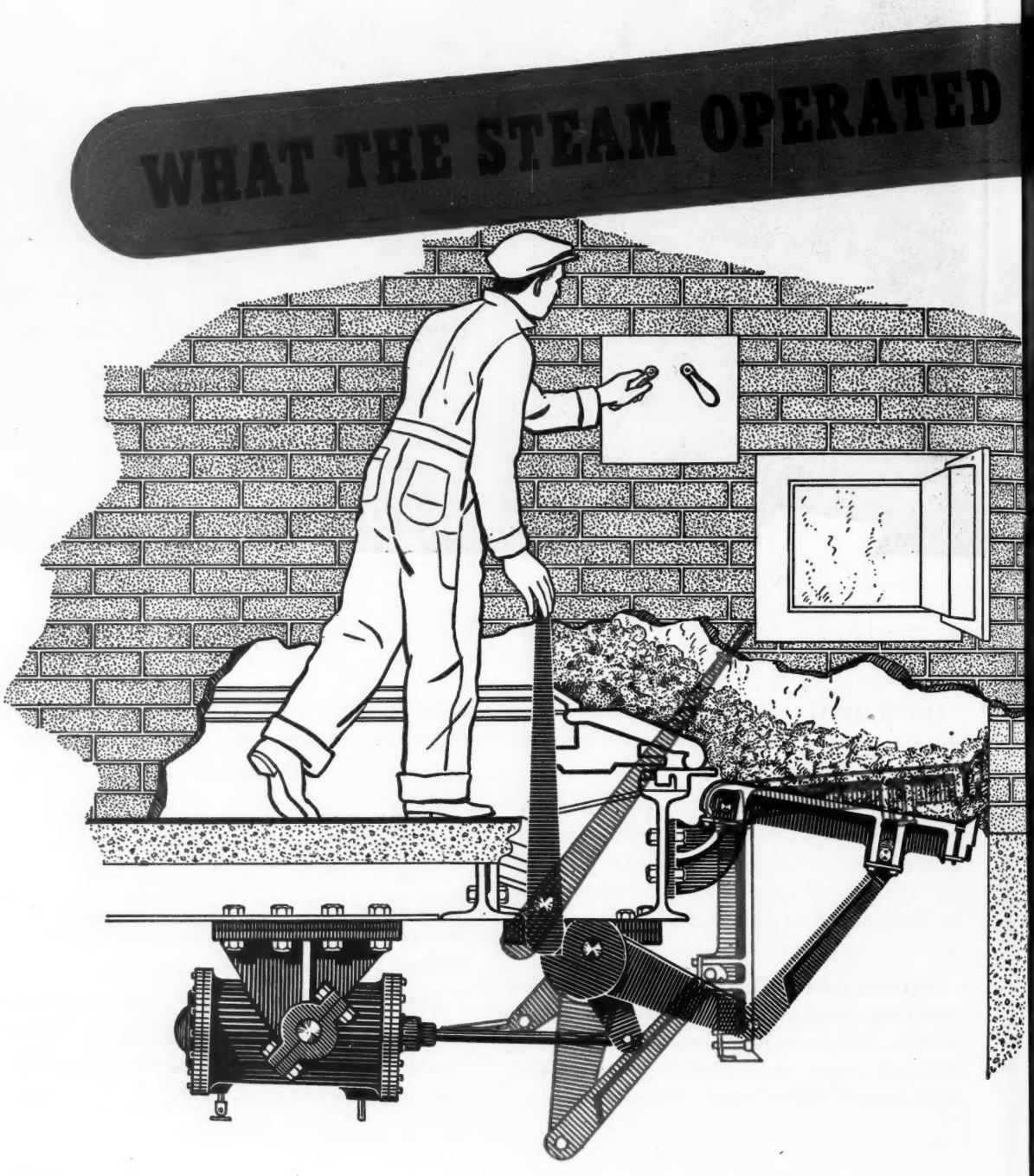
POSITIVE LUBRICATION . . . assured by ring-oiled bronze bearings lined with tin-base babbitt. Either bearing may be removed by unbolting bearing cover.

EFFICIENT CARBON GLANDS . . . held around the shaft by stainless steel garter springs, control steam leakage at points where the rotor shaft extends through the casing. A leak-off at each gland minimizes leakage past the outer ring.

EACH TURBINE FACTORY TESTED . . . by a running trial with steam for adjusting governor, setting overspeed trip, checking smoothness of operation, testing glands and steam joints. J-50447

Steam Headquarters **Westinghouse**

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE


WHAT THE STEAM OPERATED

ASH DISCHARGE MEANS TO...

STOKER PERFORMANCE

WHERE there is a limited load condition and the use of furnace water cooling is not justified, Taylor Stoker design includes the Steam Operated Ash Discharge. With this feature ashes can be dumped and bridge wall sheared free of clinkers in a fraction of a minute without manual labor.

Due to an exclusive feature of the Taylor Steam Operated Ash Discharge, clinkers may be cleared from the rear wall anytime between dumping periods. This means removal while they are in plastic condition, preventing injury to the brick work.

Aside from ease of operation and lower brick work maintenance costs, the Steam Operated Ash Discharge has five other features that improve stoker operation or lower operating expenses:

1. Single leaf dump plate provides maximum discharge area.
2. There are no right and left sections so that all plates are interchangeable.
3. Dump plates are heavy cast iron.
4. Dump plates can be removed by simply knocking out two pins.
5. Controls are conveniently located so operator can readily observe dump plate while controlling its movement.

It is the combination of many advantages such as the Steam Operated Ash Discharge that make the Taylor Stoker a highly efficient unit, low in operating and maintenance costs.

JUDGE THE SELECTION OF FUEL FIRING EQUIPMENT BY THESE TWELVE POINTS

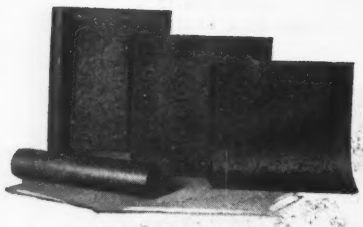
1. **RELIABILITY**—the ability to operate with minimum outage and minimum standby equipment.
2. **CAPACITY**—the ability to provide adequate prime capacity ratings, with sufficient reserve capacity for emergencies.
3. **MAINTENANCE**—the ability to operate continuously with minimum repair costs.
4. **FLEXIBILITY**—the ability to follow the steam demand upward or downward . . . quickly and without sacrificing efficiency.
5. **EFFICIENCY**—the proved dollar efficiency (total cost of steam production) as shown by actual performance in similar installations.
6. **OPERATION**—the ability to operate continuously, the number and type of operations required, the ease of combustion adjustments, etc.
7. **ADAPTABILITY**—the ability to meet special and limiting conditions, present and future—structural limitations, utilization of present equipment, growth and change of power service demands.
8. **FUEL FLEXIBILITY**—the ability to burn efficiently and easily fuels from many sources having widely varying characteristics.
9. **REFUSE DISPOSAL**—the ability to economically eliminate ash or refuse and the opportunities of disposal at low cost, no cost, or profit.
10. **STACK DISCHARGE**—the practical elimination of "smoke nuisance" without special equipment.
11. **SPACE REQUIREMENTS**—the ability to conform to existing or future space limitations, to short and wide or long and narrow furnaces. Also the accessibility of component parts for maintenance and operation.
12. **OBSOLESCENCE**—the adaptability of the equipment toward possible future modernization with minimum of complication and outage.

A-E-CO TAYLOR STOKERS • LO-HED HOISTS
HELE-SHAW FLUID POWER • MARINE DECK AUXILIARIES

AMERICAN ENGINEERING COMPANY

PHILADELPHIA 25 • PENNSYLVANIA

Garlock Helps Fuel the Bombers to Blast the Axis



GARLOCK 7021 Compressed Asbestos Sheet Packing is a superior gasketing material for severe conditions, such as super-heated steam at extreme pressures and light oils at high temperatures. Thicknesses 1/64" to 1/4". Sheets 40" x 40" and larger.

Our big 4-engined bombers with their loads of blockbusters use tons of gas on every mission. The dependable performance of GARLOCK packings, gaskets and KLOZURE oil seals in the production, refining and transportation of petroleum products, helps keep our planes supplied with fuel.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

In Canada:
The Garlock Packing Company of Canada Ltd.
Montreal, Que.

GARLOCK

Philadelphia

GEARED SPEED REDUCERS

ONE NAME — ALL TYPES

WORM GEAR SPEED REDUCERS

Our standard type Worm Gear Speed Reducers are made in both horizontal and vertical types . . . in a wide range of ratios and horsepowers. Catalog No. 25 gives construction details, dimensions, typical installations, etc.

HERRINGBONE SPEED REDUCERS

are available in single, double and triple reduction types. Standard ratios range from 1.75 to 1 up to 300 to 1. Efficiencies up to 98%. These units are also suited for speed increasing. Catalog H-39 contains full information.

SPIRAL-BEVEL SPEED REDUCERS

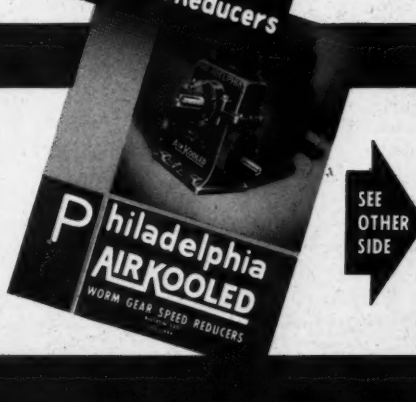
for right angle drives where high efficiency and smooth operation are desired. Efficiencies same as our Herringbone Speed Reducers. Available in single, double and triple reduction types in standard ratios from 1 to 1 up to 238 to 1. Full information in our Bulletin 200.

PLANETARY SPEED REDUCERS

are straight line type of reduction units, employing the same planetary principle of reduction that proved so successful in our MotoReduceRs. Single, compound and double reduction types, with ratios from 4 to 1 to 106 to 1. Sizes up to 100 horsepower. For full information get our Bulletin 100.

AIRKOOLED WORM GEAR SPEED REDUCERS

. . . offer considerably greater horsepower ratings than standard heavy duty type units for worm speeds of 580 to 1750 RPM. Suction fan on worm shaft draws cool air through double walled ribbed housing. Unit being more compact saves weight and space. Our bulletin 250 gives all the facts.



SEE OTHER SIDE

Philadelphia

POWER SAVING PRODUCTS

PHILADELPHIA MOTOREDUCER

. . . self-contained . . . motor and planetary type speed reducer in single, compact housing. Horizontal and vertical types. Numerous distinctive design features. Wide range of ratios and horsepowers. Complete description in catalog M. R. 40.

PHILADELPHIA GEARS

are made in all types and sizes for industrial service. In our shop we have the most modern equipment for producing gears accurately. Our gear catalog is a guide for all gear buyers and users.

PHILADELPHIA COUPLINGS

can be supplied in a number of different types to meet various requirements. Illustrations, descriptions and dimensions are included in our new Coupling catalog.

LIMITORQUE VALVE CONTROLS

are efficient, mechanically actuated devices for operating valves on steam, air, gas, water and oil lines. Operates by push button . . . saves time, trouble. Doors, damper controls, sluice gates, etc. offer further applications—Can be fitted to present equipment. Limitorque Control catalog shows the several types.

SEE OTHER SIDE

Gentlemen:

Please send me the following Philadelphia Catalogs:

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Mr. .....

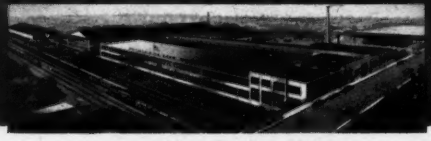
Firm ..... Title .....

Address .....

A B C D E F G

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

ARMY (E) NAVY



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GEAR WORKS INCORPORATED

ERIE AVE. AND G ST., PHILADELPHIA 34, PA. NEW YORK · PITTSBURGH · CHICAGO

A COMPLETELY NEW PNEUMATIC TRANSMITTER

For Measuring Flow and Level

A new metering device operating on the Force-Balance Principle

Republic announces an entirely new type of pneumatic meter which has been thoroughly field tested during the past two years. The Republic Differential Pressure Transmitter is a simple pneumatic device for converting a differential pressure, such as is produced by the flow of a fluid through an orifice or by liquid level in a vessel, into an air pressure which varies proportionately with the differential pressure.

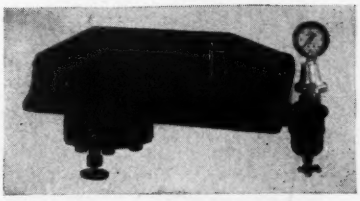
This air pressure is used as a direct measure of the differential pressure and can be conducted to a remote location by means of tubing. A gage or receiver connected anywhere in this transmission line will show the variations in the differential pressure and may be graduated in terms of the flow or level which it represents. The pressure can also be utilized as the impulse for actuating a controller.

RANGES—standard ranges are available from 0.9 in. to 25 in. of water differential, for working pressures up to 15 psi.; 7 in. to 50 in. of water for working pressures up to 25 psi.; and 13 in. to 800 in. of water for working pressures up to 600 psi. Special heads can be provided for working pressures up to 2000 psi.

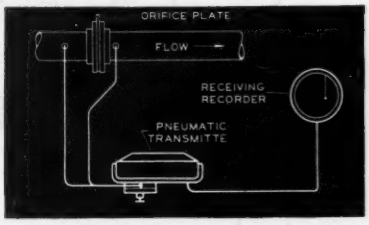
ACCURACY of the Republic force-balance method of measurement is higher than can be consistently secured and maintained with any other method. Transmitting pressure vs measured differential is guaranteed within ½ of 1% of meter range.

SENSITIVITY—due to the negligible motions required for complete operation of all parts for full scale change, no appreciable hysteresis results from reversal of direction of measurement change. The hysteresis loop is so small that it is undetectable by ordinary means, being less than 1/20 of 1%.

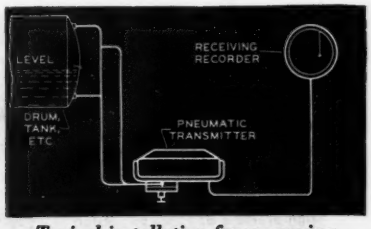
RESPONSIVENESS—due to the fact that there is virtually no volume displacement, the Republic Pneumatic Transmitter is able to follow flow changes almost instantaneously. The time required to produce full output pressure at the transmitter is in the nature of fractions of a second, after the differential is imposed. Therefore a receiving instrument installed adjacent to the transmitter will show flow changes almost instantly. With 500 feet of ¼ in. O.D. tubing, the full value of the change will have registered on a Republic receiver in 15 seconds. This is the overall lag in the system not merely, the transmission lag.



The Republic Differential Pressure Transmitter.



Typical installation for measuring flow.



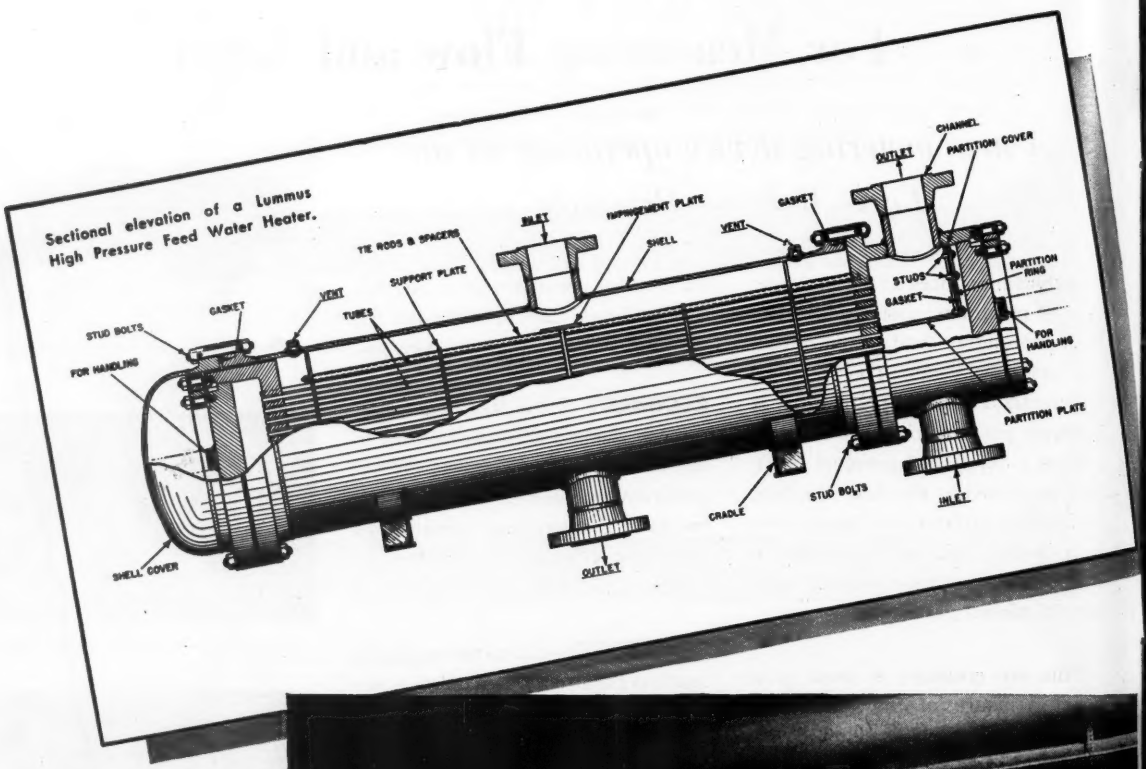
Typical installation for measuring liquid level.

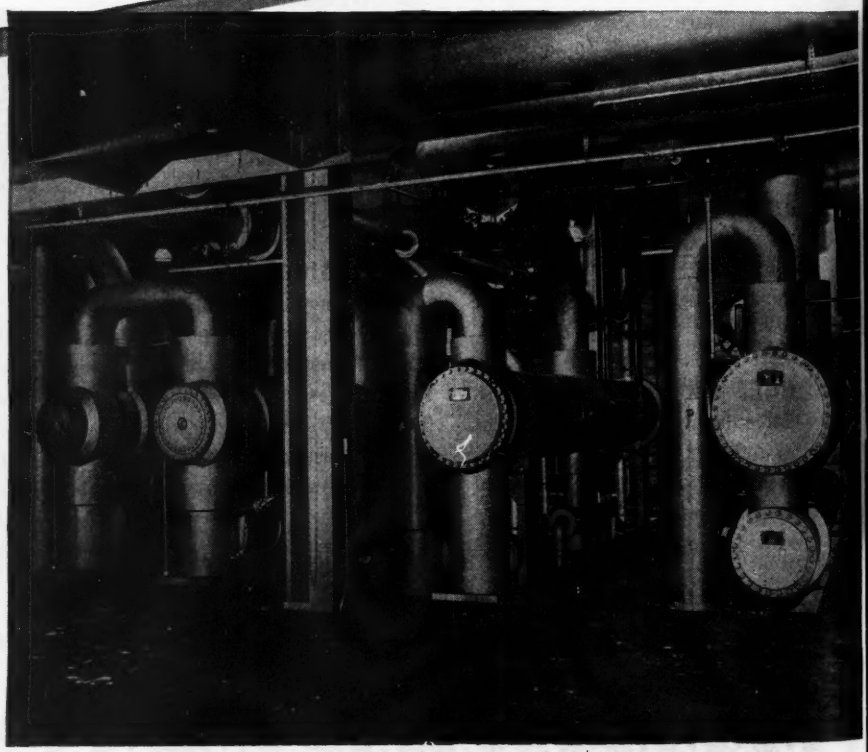
For complete data write for Bulletin No. 43-4

REPUBLIC FLOW METERS CO.

2224 Diversey Parkway, Chicago, Illinois

DESIGNED and





FEED WATER HEATERS and HEAT EXCHANGER: Left to right, the installation consists of—*Two high pressure feed water heaters:* design pressure of 1,100 psi; tested at 2,200 psi on the tube side: effective surface areas, 935 and 1,355 square feet respectively. Each employs the Lummus MULTI-LOCK (patented) CLOSURE for the channel and floating heads as shown in the sectional drawing. *One intermediate pressure heater* and *one low pressure heater* employing conventional pull-through floating head construction: effective surface areas, 1,310 and 1,750 square feet respectively. *One feed water-condensate exchanger:* fixed tube sheet construction; effective area, 1,040 square feet.

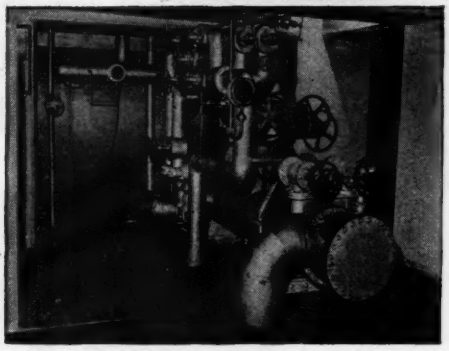
BUILT by LUMMUS

for Ohio Edison Company

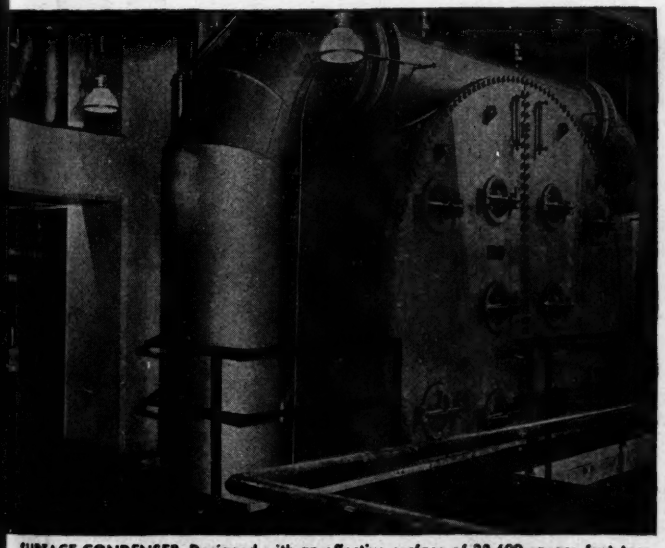
Lummus Equipment . . . for the new unit having a capability of 44,000 KW installed in the Gorge Power Station of Ohio Edison Co. on the Cuyahoga River, Akron, Ohio, is in dependable base load operation furnishing service to important war industries, cities and communities in Northeastern Ohio.

Lummus engineering service is always available for the study of specific heat exchanger problems for power plant modernization and post war requirements. For further information write to:

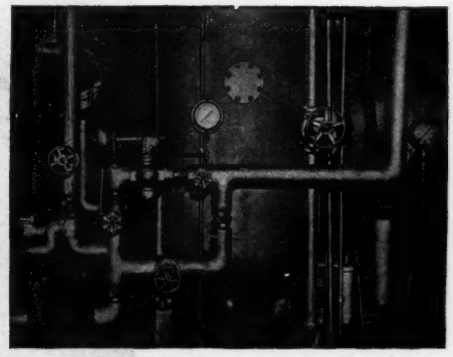
THE LUMMUS COMPANY • 420 LEXINGTON AVE., NEW YORK 17



STEAM JET AIR PUMP: Two-stage, twin element unit with surface type combined inter-and-after condenser. Each twin element evacuates 53 pounds of dry air per hour. Vacuum is maintained at 29 inches Hg, referred to 30-inch barometer.



SURFACE CONDENSER: Designed with an effective surface of 32,600 square feet to condense 350,000 pounds of steam per hour. Vacuum is maintained at 27.87 inches Hg, referred to 30-inch barometer.



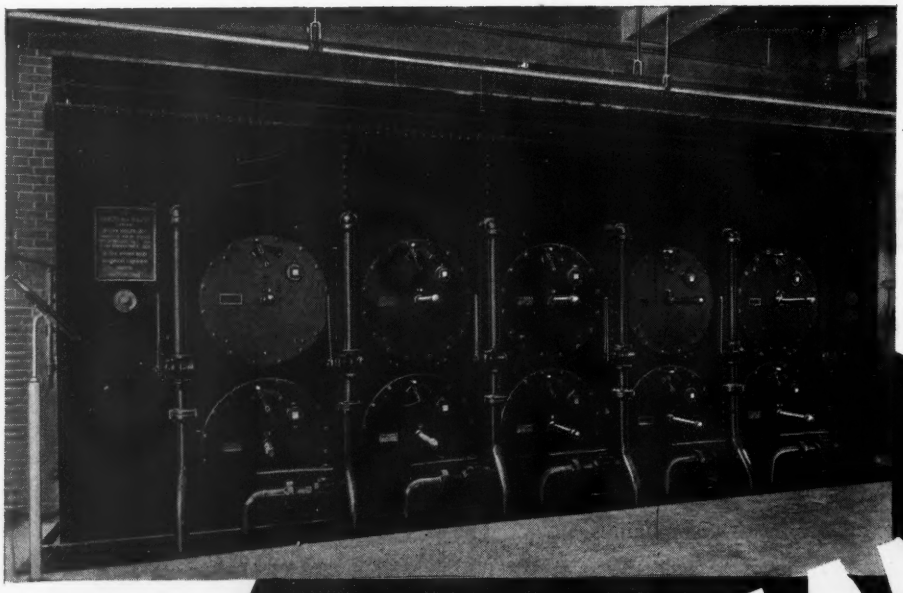
EVAPORATOR: Vertical construction with U-tube bundle; effective surface area 406 square feet; evaporating capacity, 12,000 pounds of water per hour.

LUMMUS

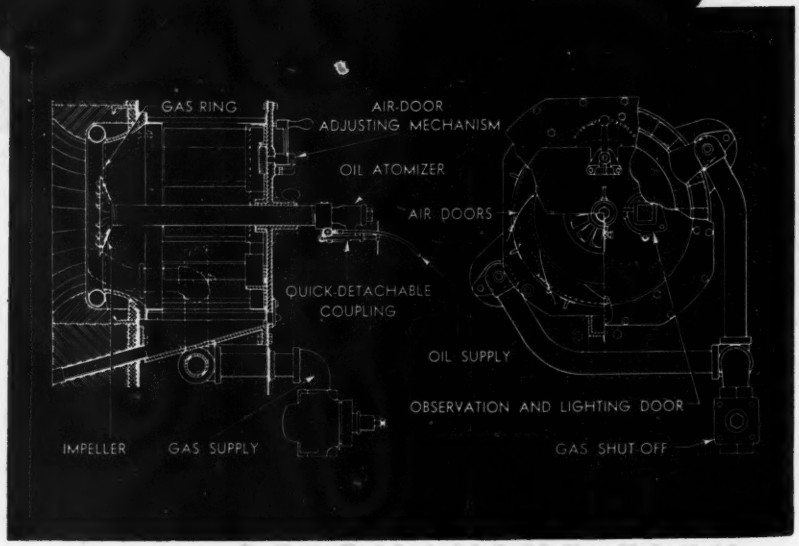
HEAT EXCHANGERS

LUMMUS POWER PLANT EQUIPMENT

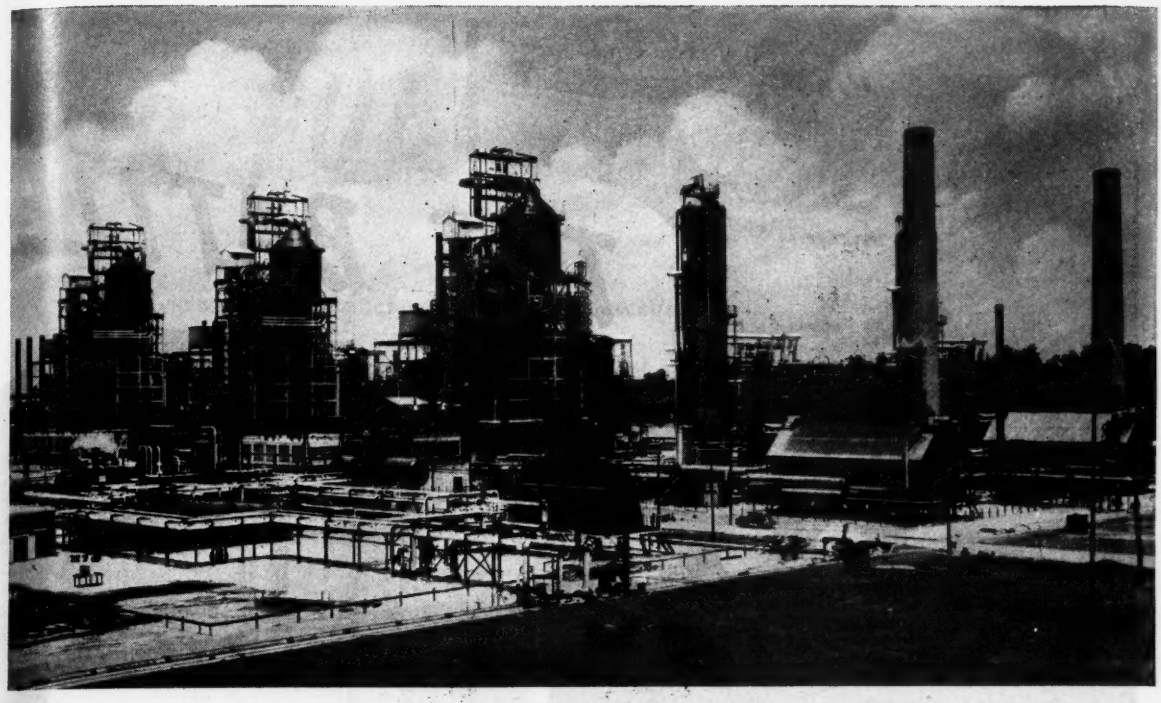
SURFACE CONDENSERS
STEAM JET AIR EJECTORS
BLEEDER HEATERS
BOILER BLOWDOWN HEAT EXCHANGERS
EVAPORATORS
FUEL OIL HEATERS
LUBRICATING OIL COOLERS



THIS TEAM



Combination fuel gas and oil burners of this type are installed on boilers at Lake Charles.



View of Topping Units (right) and three Cracking Units (left) at new Lake Charles plant of Cities Service.

Lake Charles

Six Babcock & Wilcox boilers help to provide power and process steam for the new giant Cities Service refinery at Lake Charles, Louisiana. Two are the B&W Integral-Furnace type, and teamed with them are 23 B&W burners on these and other boilers in the plant.

Providing tankfuls for task fliers calls for uninterrupted production . . . makes "steam up" as important as "on stream" . . . demands a high standard of efficient performance from generating equipment. B&W Integral-Furnace Boilers are a "known quantity", proved dependable in war industries as in pre-war services . . . now serving steel mills as well as refineries; arsenals and aircraft factories as well as butadiene plants.

Experience gained in unprecedented war-time assignments added to years of steam progress, will be reflected in the service of B&W Integral-Furnace Boilers to post-war industry.

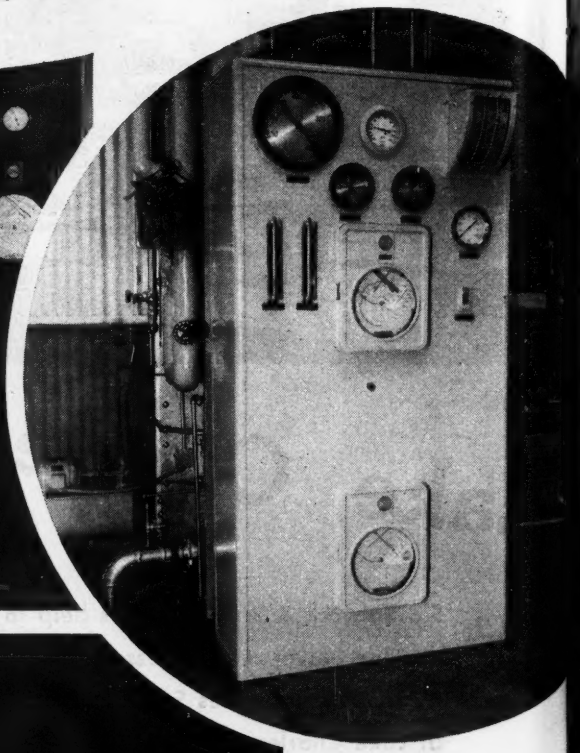
BABCOCK & WILCOX

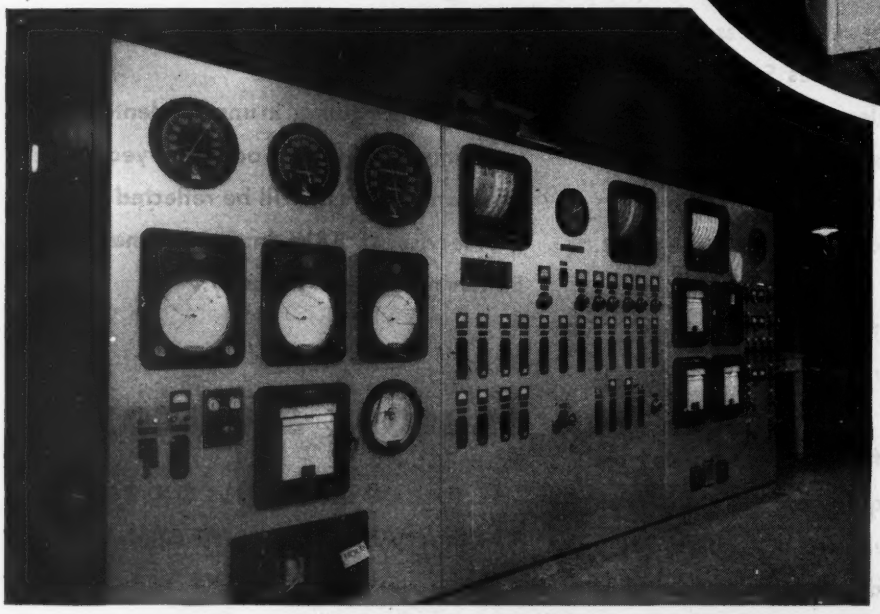
THE BABCOCK & WILCOX CO.

BUY MORE WAR BONDS

G-2767

THE BATTLE





Bailey Meters and Contr
save both fuel and manpow
by automatically maintaini
optimum conditions in t
generation and utilization
heat units.

BAILEY METER CONTROL

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERH

FOR FUEL

★ Early victory on the battlefield will not cancel the battle for fuel—it will be fought in fuel-burning plants everywhere this winter. In the case of coal, it is estimated that requirements will exceed production by 30 million tons. Since stock piles are at an all time low, rigid conservation must be practiced.

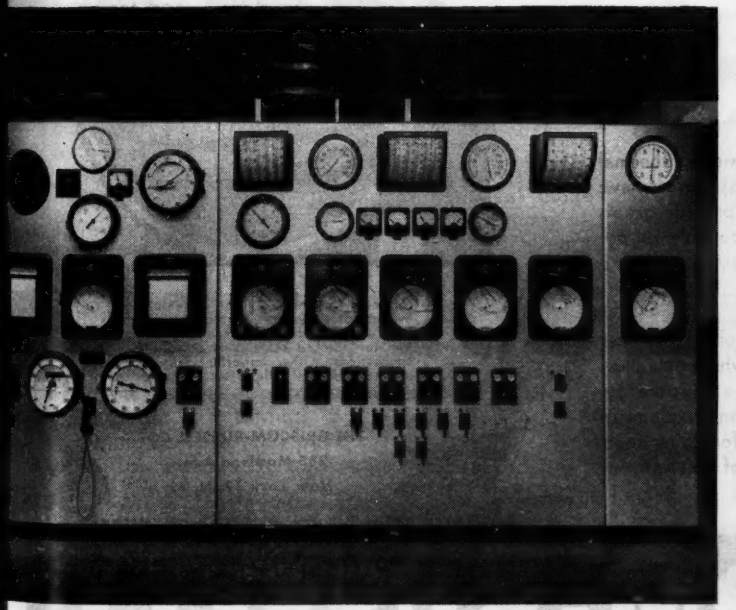
It is the duty of every Engineer who is responsible for the burning of fuel to cooperate with the National Fuel Efficiency Program. He should give careful attention to economy in both the generation and utilization of steam and heat. In this task Bailey Meters and Bailey Meter Control provide the means for—

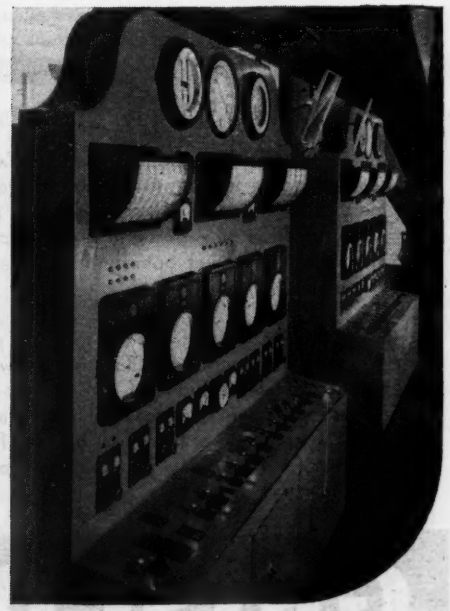
1. Determining true combustion conditions.
2. Accurately measuring and recording heat units both at the point of generation and at the point of consumption.
3. Duplicating conditons which have been determined by test to result in the highest economy.
4. Continuously and automatically maintaining optimum conditions during routine operation.

How Bailey Equipment and Bailey Field Engineers help you to save both fuel and manpower is outlined in Bulletin 15-B. Write for your copy today.

G-23

BAILEY METER COMPANY
1040 IVANHOE ROAD • CLEVELAND 10, OHIO
Bailey Meter Company Limited, Montreal, Canada





. . . The Complete Boiler Control System

TROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

28 FEATURES of G-R BENTUBE EVAPORATORS

that every plant engineer should know about

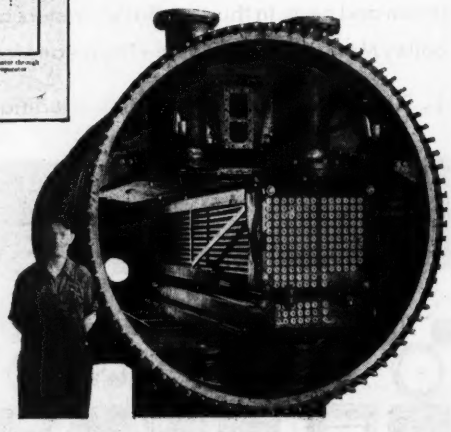
GRISCOM-RUSSELL EVAPORATORS

Features of G-R Bentube Evaporator Elements

THE GRISCOM-RUSSELL COMPANY

Features of G-R Bentube Evaporators

Griscom-Russell
Bentube
EVAPORATORS



This end view of G-R Type J Bentube Evaporator shows the low tube bundle, large vapor space, ample space at bottom for cracked scale, and accessible connections. Other important features are described in Bulletin 362.

IN addition to their famous thermal scale-shedding feature, G-R Bentube Evaporators have more than two dozen advantages which provide greatest production of vapor with greatest possible purity, and most convenient operation with least attendance and maintenance expense.

These features . . . of interest to every plant engineer . . . are fully described in Bulletin 362, which also illustrates the various types of G-R Bentube Evaporators for large, medium and small capacities, and explains in detail when evaporators should be used for boiler feed make-up. Write today for your copy of this informative bulletin.

THE GRISCOM-RUSSELL CO.
285 Madison Ave.
New York 17, N. Y.

GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus

NO REPLACEMENTS OF *Springfield* CAST STEEL MUD DRUMS

SINCE Springfield adopted cast steel for mud drums, over ten years ago, not one has been replaced. This is noteworthy as the mud drum of the boiler is less accessible than other parts for cleaning and inspection and is, therefore, the most likely spot for corrosion or pitting.

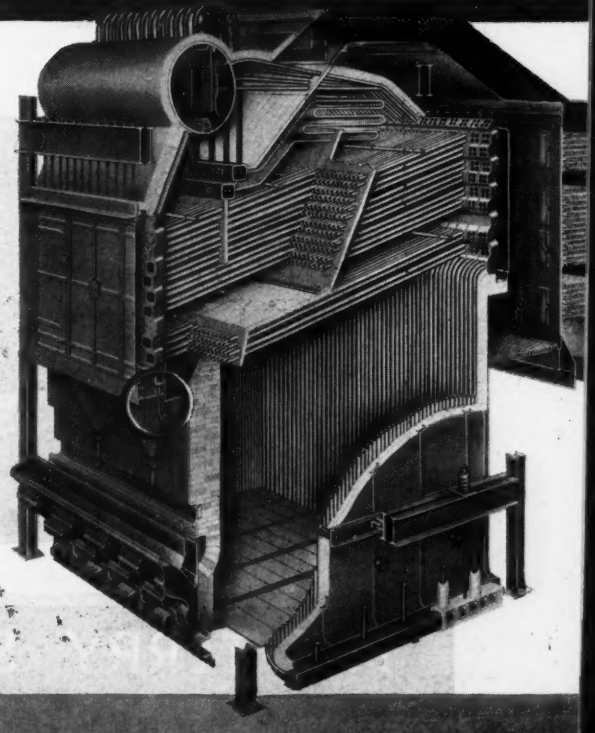
Originally the mud drums of Springfield Boilers were made of seamless steel pipe pressed to shape, as still used by other manufacturers. Replacements due to corrosion and pitting prompted us to seek some more suitable material for this vulnerable boiler part and so, in 1933, we started making our mud drums of the same material that had already proven so satisfactory in our sectional boiler headers—cast steel. Hundreds now in service with no indication of corrosion or pitting in any of them prove that our cast steel mud drums will give the same long service as our cast steel boiler headers.*

Resistance to corrosion is only one of the advantages of cast steel construction. Cast steel makes possible improved design. Ribbing and increased thickness are possible where greater wall strength is required. Tighter tube joints are possible because the softer metal of the tube (112 to 120 Brinell) is rolled into the harder cast steel (175 to 185 Brinell) under tremendous pressure. A wide variety of designs is made possible by casting, permitting flexibility to best meet requirements.

Through and through Springfield Boilers reflect advanced design that pays big dividends. Consider the plus values of a Springfield on your next boiler purchase.

CAST STEEL MEETS ALL REQUIREMENTS

Springfield header steel is produced by the Electric Furnace process with accurate control of chemical analysis. Foundry practice based on experience assures sound castings— fully annealed before leaving the foundry. Steel in the finished header is ductile as illustrated by the twisted and bent specimens and a 30" long turning produced in boring the header. Analysis and physical properties will comply with all construction Code requirements. Carbon steel, used for Springfield headers under 600 lbs. working pressure, tests 72,000 lbs. per sq. in. minimum tensile strength. For higher working pressures, strength is increased by use of alloy steel and ranges from 85,000 to 105,000 lbs. per sq. in. tensile strength.



SPRINGFIELD BOILER COMPANY

1951 East Capitol Avenue, Springfield, Illinois

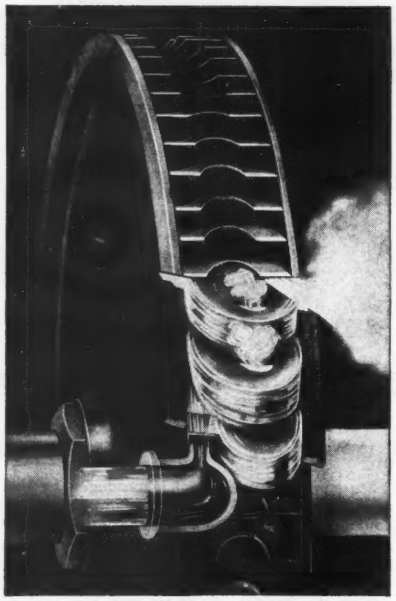
**The probable life of these headers has not yet been determined as the earliest Springfield headers, now more than 30 years old are still in service.*

SPRINGFIELD

STEAM GENERATING UNITS

ANY SIZE ANY FUEL ANY PRESSURE

The TERRY



Action of steam in Terry Solid Wheel Turbine. The steam issues from an expanding nozzle at high velocity and enters the side of the wheel bucket, in which its direction is reversed 180°. The steam is caught in a stationary reversing chamber and returned to the wheel. This process is repeated several times.

USES A SOLID STEEL ROTOR

The rotor of the Terry Wheel Turbine is made from a single forging of speci composition steel. The semi-circular buckets or pockets are milled from the sol metal. The steps in the machining of a wheel are shown below. There are no pa to become loose or work out.

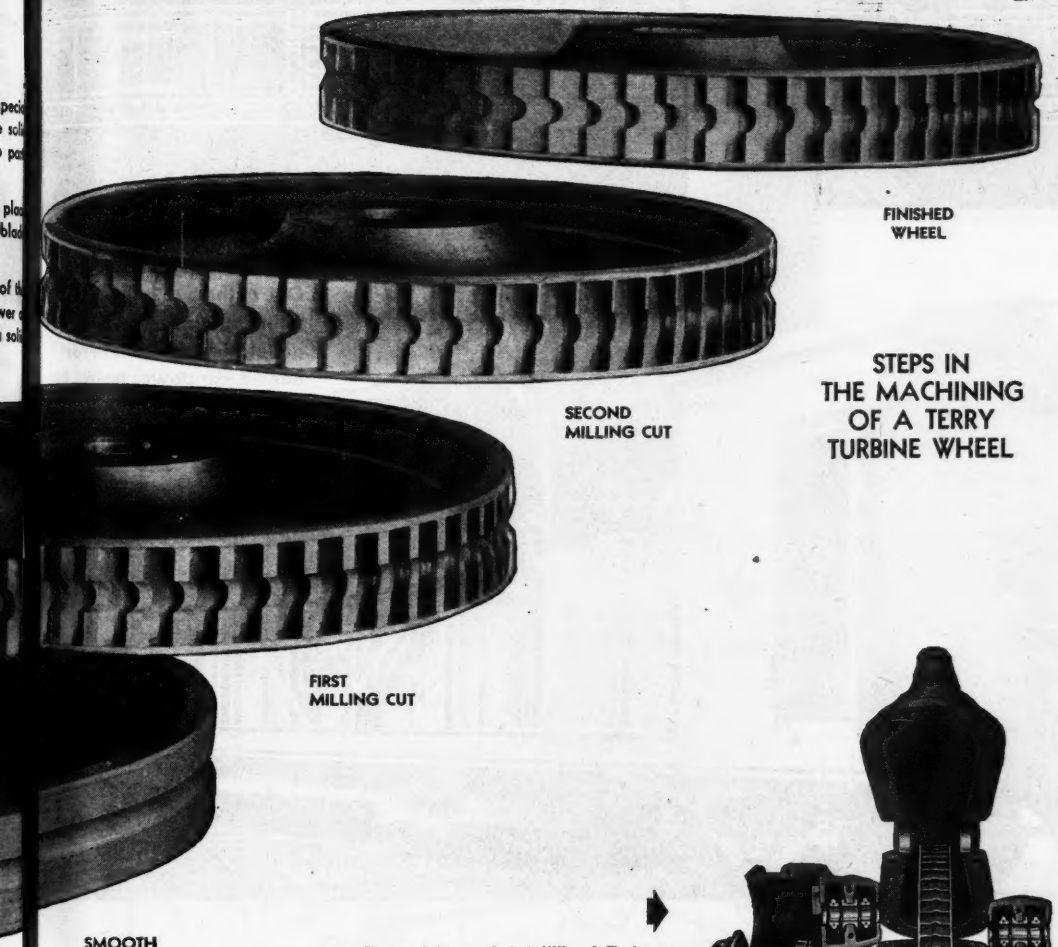
The power-producing action of the steam in the wheel buckets takes pla entirely on the curved surface at the back of the bucket and therefore close blad clearance is not necessary.

As the only function of these blades is to form a series of pockets, wear of t blades is of little consequence and does not materially affect the horse power efficiency. The important part of the bucket is the back or bottom, which is a sol forging.

FORGING — ROUGH TURNED

THE TERRY STEAM TURBINE CO.

Wheel Turbine



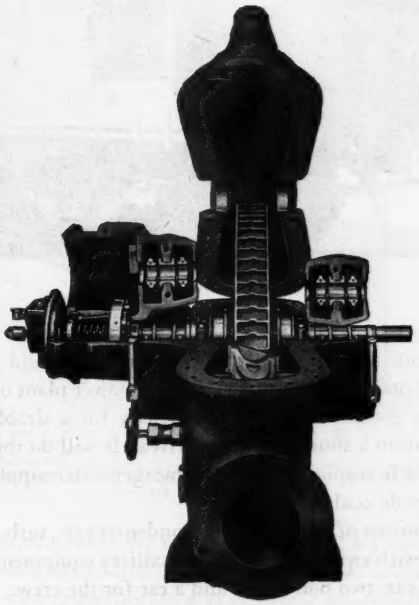
FINISHED WHEEL

SECOND MILLING CUT

FIRST MILLING CUT

SMOOTH TURNED

STEPS IN THE MACHINING OF A TERRY TURBINE WHEEL



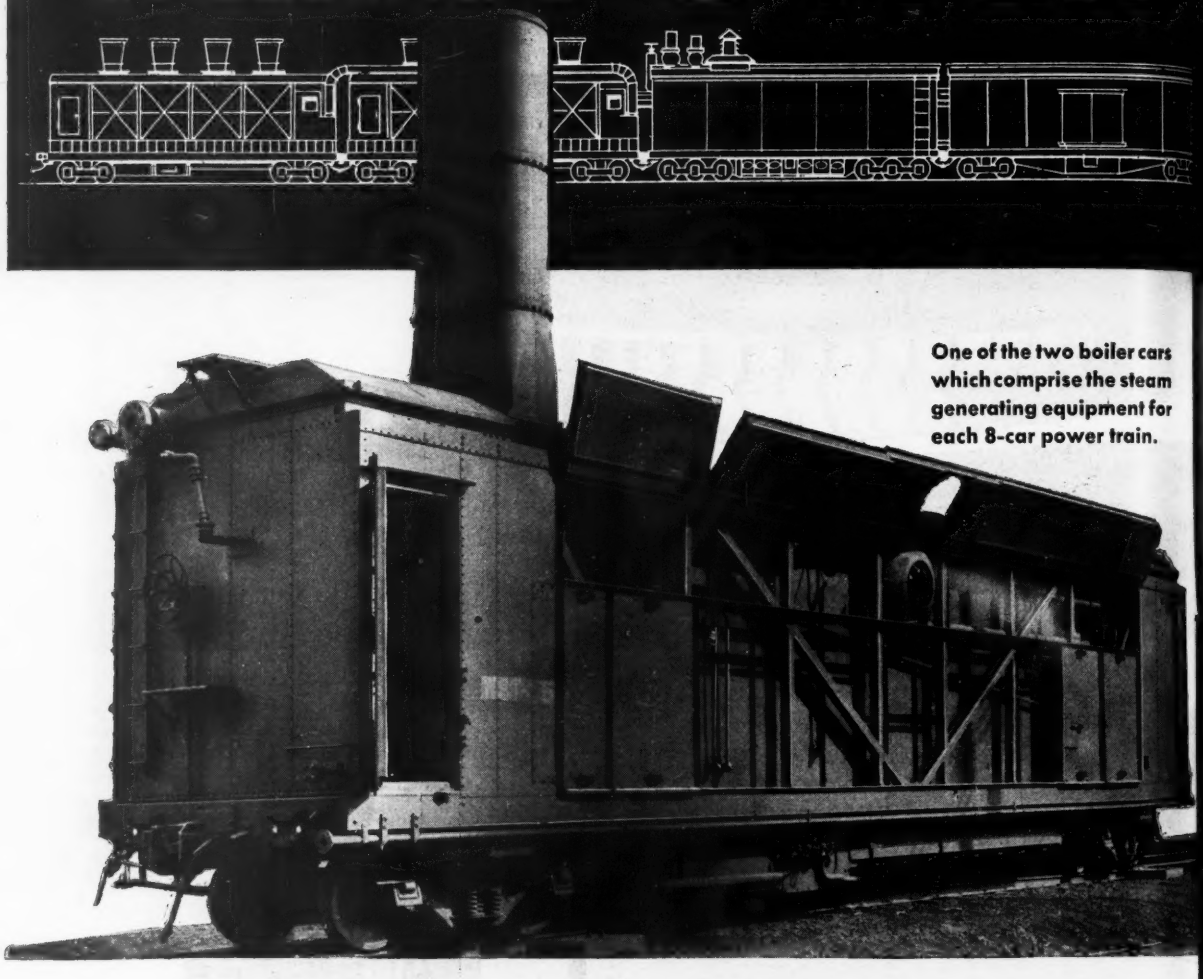
Typical Terry Solid Wheel Turbine with cover and bearing caps raised. Note the ruggedness and the accessibility of all parts. Units of this type are used to drive boiler feed pumps, generators, and all types of power plant equipment. Built in sizes from 5 H.P. to 2000 H.P.

FOR FULL DETAILS ASK FOR BULLETIN S-116

T-1156

TERRY SQUARE - HARTFORD, CONN.

SPEEDING POWER



One of the two boiler cars which comprise the steam generating equipment for each 8-car power train.

It takes from nine months to two years to rebuild a bombed or sabotaged power plant. Yet this power plant on wheels can be generating enough electricity for a sizable community within a short time after arrival. It will do this in arctic cold or in tropical heat — on a meager water supply — with low grade coal.

The train consists of two air-cooled condenser cars, turbo-generator car with switch gear, car for auxiliary equipment, water storage car, two boiler cars and a car for the crew.

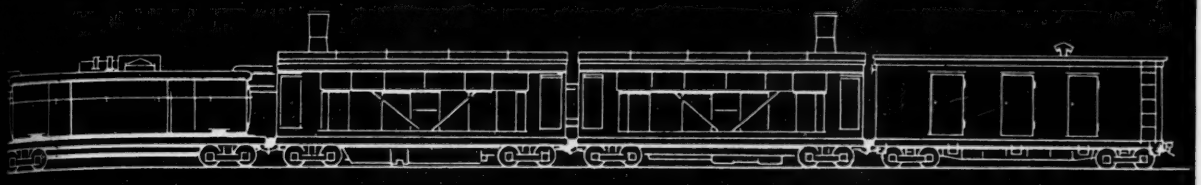
Ten such trains, each producing 5,000 kw are in process of completion. They are built by Westinghouse with boilers supplied by Combustion Engineering. These are the highest capacity trains being built for overseas use.

Numerous limitations imposed by space, weight, track clearances and other factors had to be surmounted in designing and constructing these trains. The fact that these unique problems have all been successfully solved is a tribute to the engineering skill and ingenuity of the designers of all the principal equipment comprising these moving power plants. A814

COMBUSTION

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

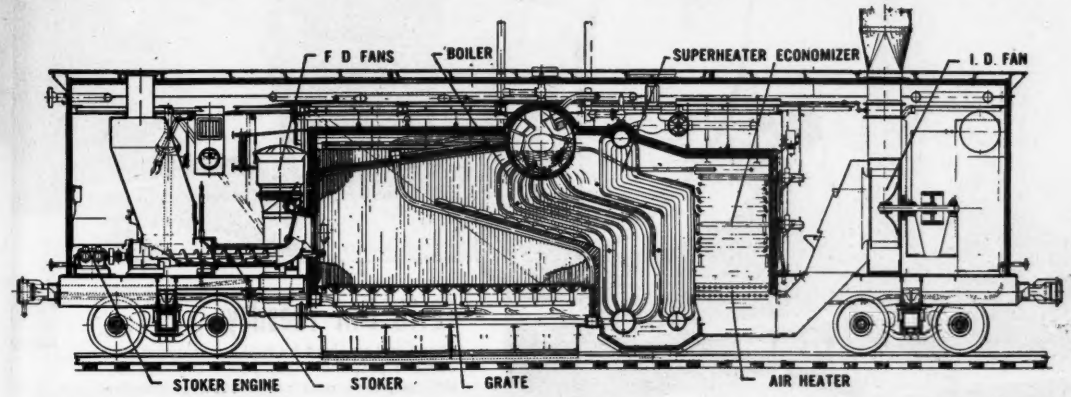
TO WAR-DEVASTATED AREAS



THE BOILERS. Arranged as illustrated in the sectional drawing shown below, the boilers are of the 2-drum, bent-tube type, having a six-steam-pass superheater, a special tubular air preheater and a marine type extended surface economizer. Serving this combination are both forced- and induced-draft fans, a water level regulator and necessary indicating instruments. Each boiler will generate 40,000 lb of steam per hr at 625 psi and 750F at the superheater outlet, from low grade coal of about 7,300 Btu.

FURNACE AND STOKER. Furnace and firing equipment include a locomotive type spreader stoker operating by compressed air, a locomotive type grate, fully watercooled furnace and locomotive type combustion arch. Furnace volume, including that between the arch and first pass, is 553 cu ft, with corresponding heat liberation at design load of 133,000 Btu per cu ft per hr. The arch assures high turbulence and control over excess air and prevents stratification and laning of gas streams.

SPECIAL AIR PREHEATER. Because the stoker engine, stoker jets and soot blowers are all operated by compressed air, the question of compressor power as well as size of this equipment was an important one. It was met by a novel application of a C-E Air Preheater, designed to handle compressed air, which is delivered to the stoker engine and jets at 100 lb pressure and 450F. By this means an adequate volume of air at proper pressure is supplied at a considerable saving in the power required to produce it as well as in the weight of the equipment and the space it occupies.



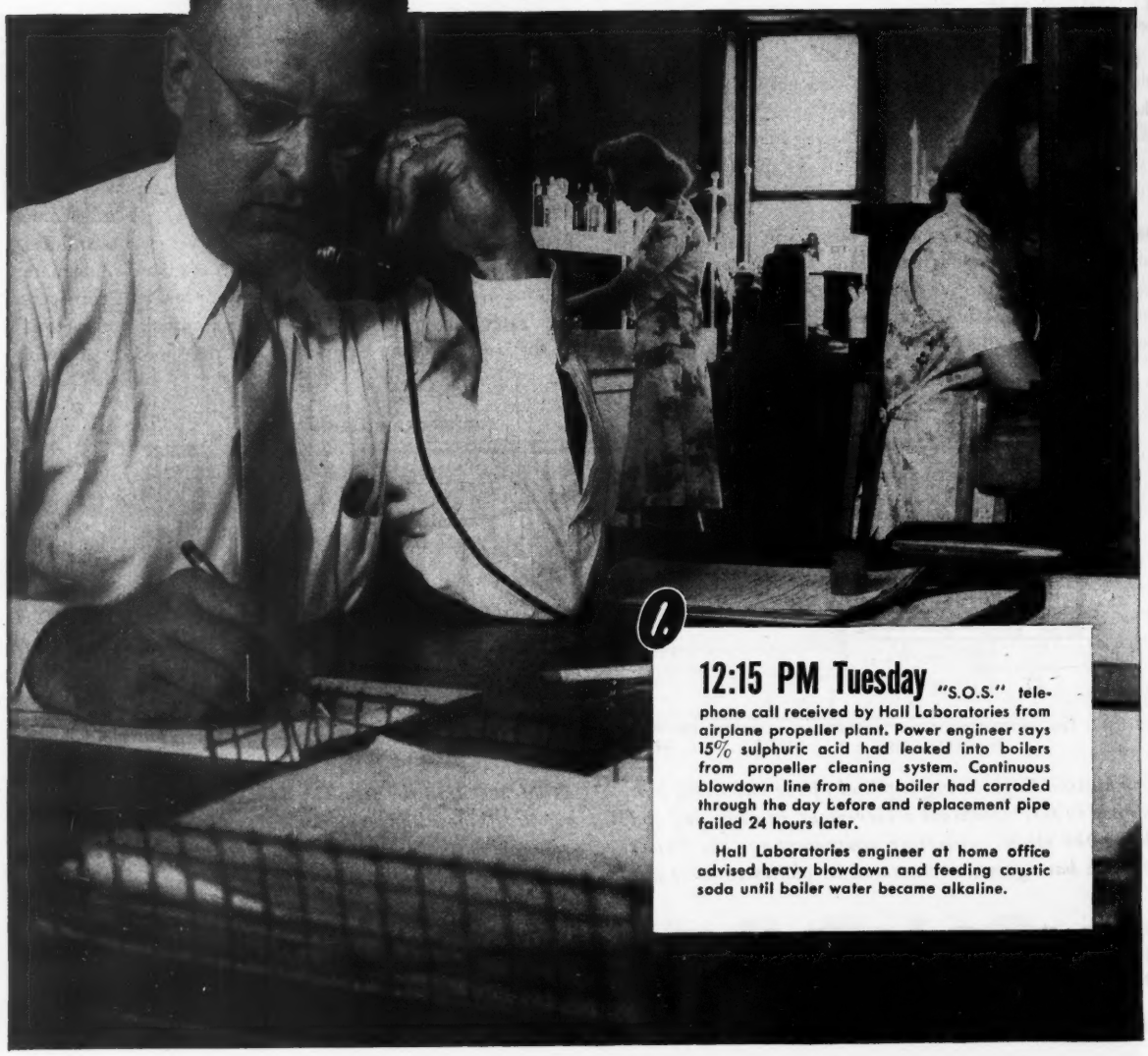
Combustion Engineering is proud of the important part it has had in this significant achievement. In designing and building the steam generating equipment for the Power Train C-E has again demonstrated its ability to meet any problem within the scope of its field. This ability and the resourcefulness and experience it reflects, are available to you now in finding the best economic solution to your post-war steam generating problems.

ENGINEERING C-E

200 MADISON AVENUE, NEW YORK 16, N. Y.

Sulphuric acid in boilers threatens shutdown of propeller plant

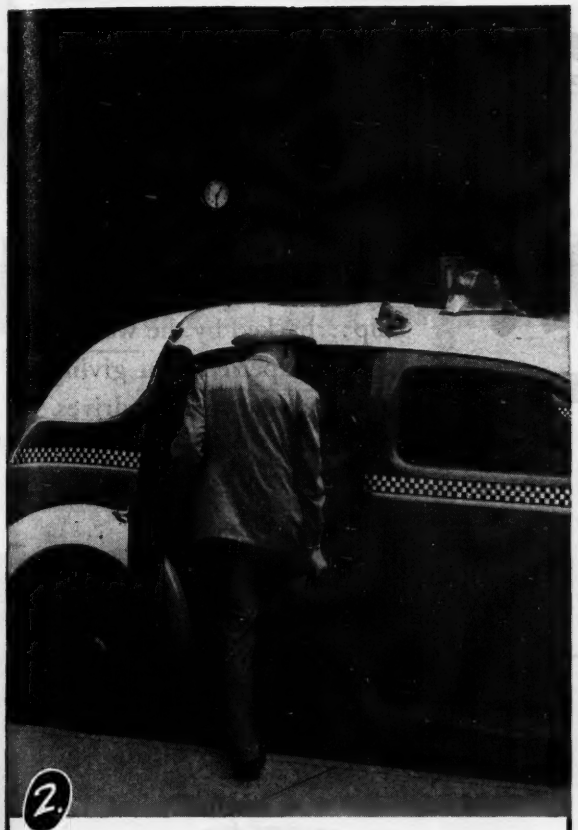
Quick action by Hall Service Engineers saves vital war production boilers



1.

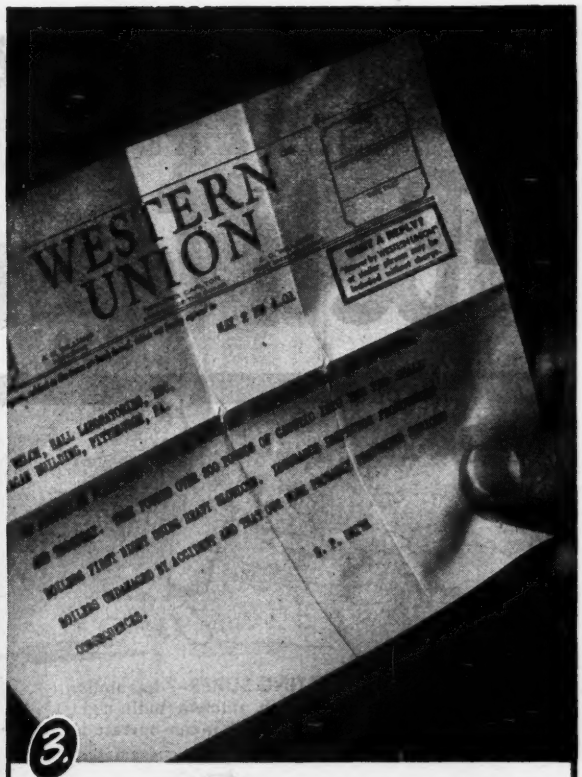
12:15 PM Tuesday "S.O.S." telephone call received by Hall Laboratories from airplane propeller plant. Power engineer says 15% sulphuric acid had leaked into boilers from propeller cleaning system. Continuous blowdown line from one boiler had corroded through the day before and replacement pipe failed 24 hours later.

Hall Laboratories engineer at home office advised heavy blowdown and feeding caustic soda until boiler water became alkaline.



2.

1:30 PM Hall Field Service Engineer was located and instructed to get to propeller plant as soon as possible as boiler condition appeared serious enough to warrant shutting down boilers.



3.

4:00 PM Friday Telegram from Hall Service Engineer to home office: "At propeller plant until 1:00 AM Wednesday morning and all day Wednesday and Thursday. They poured over 200 pounds of caustic into the two small boilers first night using heavy blowdown. Insurance inspector pronounced boilers undamaged by accident and that our work probably prevented serious consequences."

THIS case history shows that, in addition to their regular work of trouble prevention, Hall Service Engineers are available and able to cope with the unexpected emergency. This is a decided advantage when added to the benefits of *Preventive Care*.

Hall *Preventive Care* is the natural and obvious remedy for unscheduled outages—the practice of scientific supervision to prevent boiler troubles due to all kinds of scale from calcium carbonate to silica, and to corrosion, embrittlement and carryover. There is no substitute for this constant scientific supervision. When the unexpected does occur, however, the Hall Service man can give you the benefit of his own experience plus that of the men who are responsible for many of the most important developments in boiler water conditioning.

HALL LABORATORIES · HAGAN BUILDING · PITTSBURGH 30, PA.

HAGAN
HALL
BUROMIN
CALGON

HALL SYSTEM *of Boiler Water Conditioning*

Hall Service in a Nutshell

At your immediate disposal are placed the technical knowledge and facilities of the pioneering leaders in scientific boiler water conditioning. In addition, with your full cooperation, Hall Service:

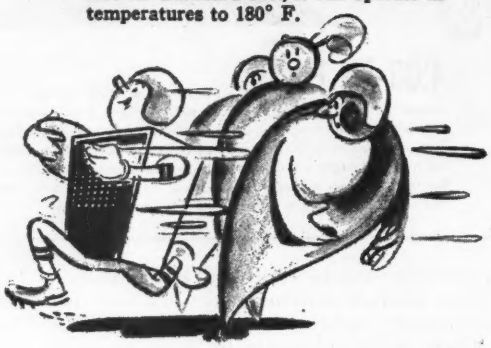
1. **Minimizes boiler outages caused by water.**
2. **Helps maintain highest efficiency.**
3. **Establishes non-embrittling water.**
4. **Minimizes carryover.**
5. **Prevents corrosion in boilers and associated equipment.**
6. **Prevents deposition in water lines and cooling systems.**

HERE'S ALLIS-CHALMERS' GREAT NEW V-Belt Team!

ALLIS-CHALMERS recommendations for belt selections are unbiased . . . because Texrope's V-belt lineup is *complete.* And as inventor of the multiple V-belt drive, A-C offers sound engineering help . . . backed by the world's longest experience in giving industry money-saving drives.

1 **HEAT-RESISTING SUPER-7** has ability to withstand high ambient built right into it. Standard belt, it can operate in temperatures to 180° F.

2 **OIL-RESISTING SUPER-7** is right for drives where fairly bad oil conditions prevail. Neoprene-covered, it resists oil spray and grease.



3 **OIL-PROOF SUPER-7,** is solid Neoprene—a synthetic unaffected by most rubber attacking liquids. Recommended for *extreme* oil conditions.

4 **STATIC-RESISTING SUPER-7** *conducts* static charge to machine for grounding charge. This safety belt is applied where explosion danger exists.

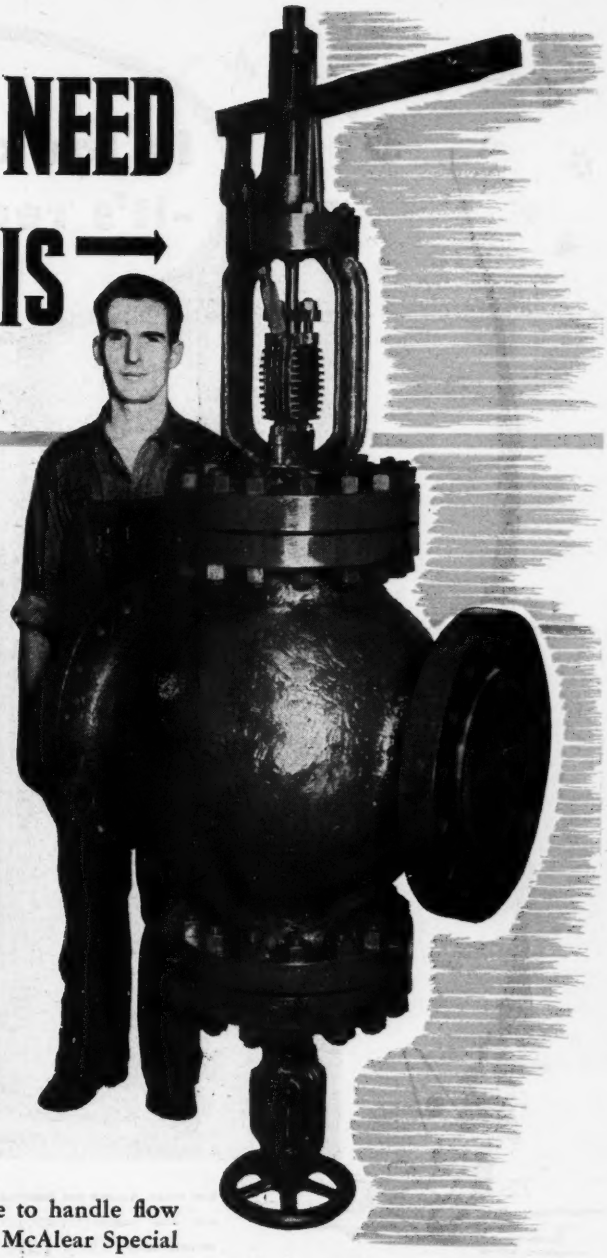
5 **SUPER-7-STEEL** employs endless steel cables to provide greater strength, reduce belt stretch. It is ideal for driving extra-heavy loads.

A 1732

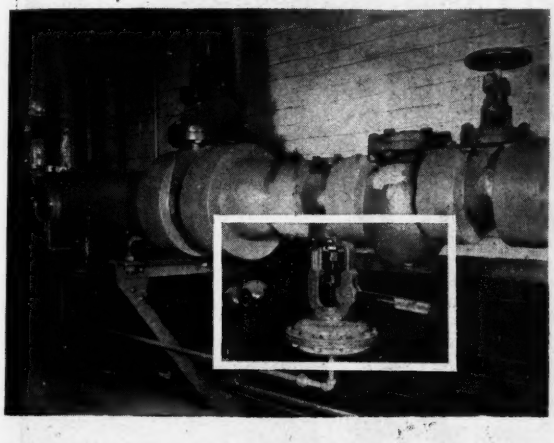
IT PAYS TO MAKE ALLIS-CHALMERS YOUR V-BELT DRIVE HEADQUARTERS

Texrope Super-7 V-Belts result from the cooperative research of two great companies—Allis-Chalmers and B. F. Goodrich—and are sold exclusively by A-C.

IF YOU SHOULD NEED A VALVE LIKE THIS →



. . . or like this



COME TO McALEAR

PERHAPS you never will require a valve to handle flow variations up to 500,000 lbs. steam per hour. The McAlear Special No. 373 Lever Valve shown at the right does just that for a large steel corporation—controlling steam flow from main boiler header to the plant distribution system.

But you *may* need a valve like that shown above—*one* of more than 500 McAlear precision controls for almost every conceivable power or process requirement.

This is No. 175 Pressure Reducing Valve—reducing steam pressure from 50 lbs. to 5 lbs. in the heating system of a large Government Housing Project. It is shown with McAlear No. 528 Strainer, ahead of the valve.

Like *every* McAlear control, regardless of its possible variant uses, these valves were each individually designed for *one* specific application—for *one* set of operating conditions—*precision engineered*, metallurgically and mechanically, to give long, trouble-free service.

For every application—involving control or regulation of temperature, flow or pressure of steam, water, air, gas, chemicals or oil—McAlear either has the control instrument you need, or—will develop a special control for you where *unusual* conditions require it. For descriptive bulletins and catalog, write McAlear Manufacturing Company, 1915 S. Western Avenue, Chicago 8. *Affiliated with: Hanlon-Waters Company, Tulsa; Climax Engineering Company, Clinton, Iowa.*

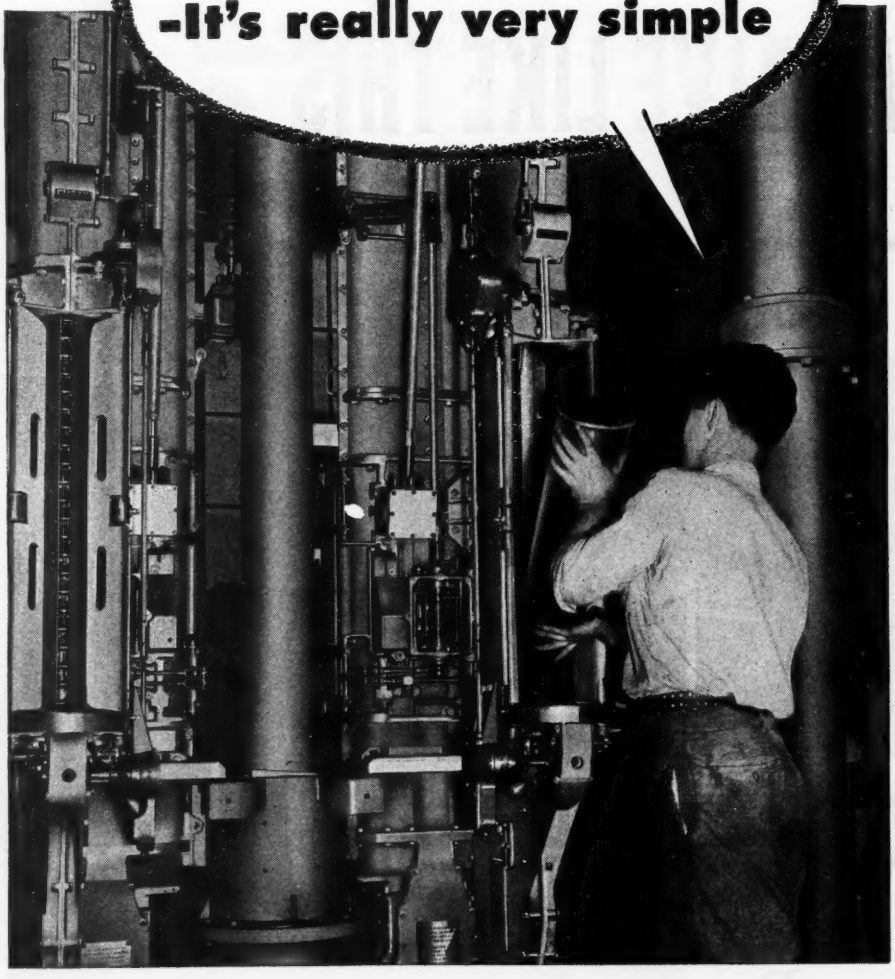
H-W McALEAR controls

PRESSURE · FLOW · LIQUID LEVEL · TEMPERATURE

WELDED TANKS
BOLTED TANKS
SEPARATORS

for STEAM, WATER, AIR, OIL, GAS

It looks Complicated -It's really very simple



"After you've worked for nearly three years on these twin ammunition hoists for the Navy, you can appreciate the simplicity of their design. There isn't an unessential part in them—and every part is made with the precision of a fine watch.

(Censored)

(Censored) They have given magnificent results in action after action, even against dive bombers. Small wonder the Japanese accuse us of having artillery which operates on the machine gun principle."

* * *

Busch-Sulzer holds the Navy E and 3 stars for its 'round-the-clock production of twin ammunition hoists ever since America entered the war. Meanwhile, we have continued to build quality Diesels for the Army, Navy, Maritime Commission and high priorities on a quantity production basis. They are of the type that has given Busch-Sulzer an enviable reputation for simplicity of design so essential to trouble-free operation and long life. An inquiry on your letterhead will receive prompt attention.

BUSCH-SULZER
ST. LOUIS

BUSCH-SULZER BROS.–DIESEL ENGINE COMPANY • SAINT LOUIS

AMERICA'S OLDEST BUILDER OF DIESEL ENGINES

Complete Encirclement

OF COAL HANDLING PROBLEMS THROUGH S-A ENGINEERING AND EQUIPMENT

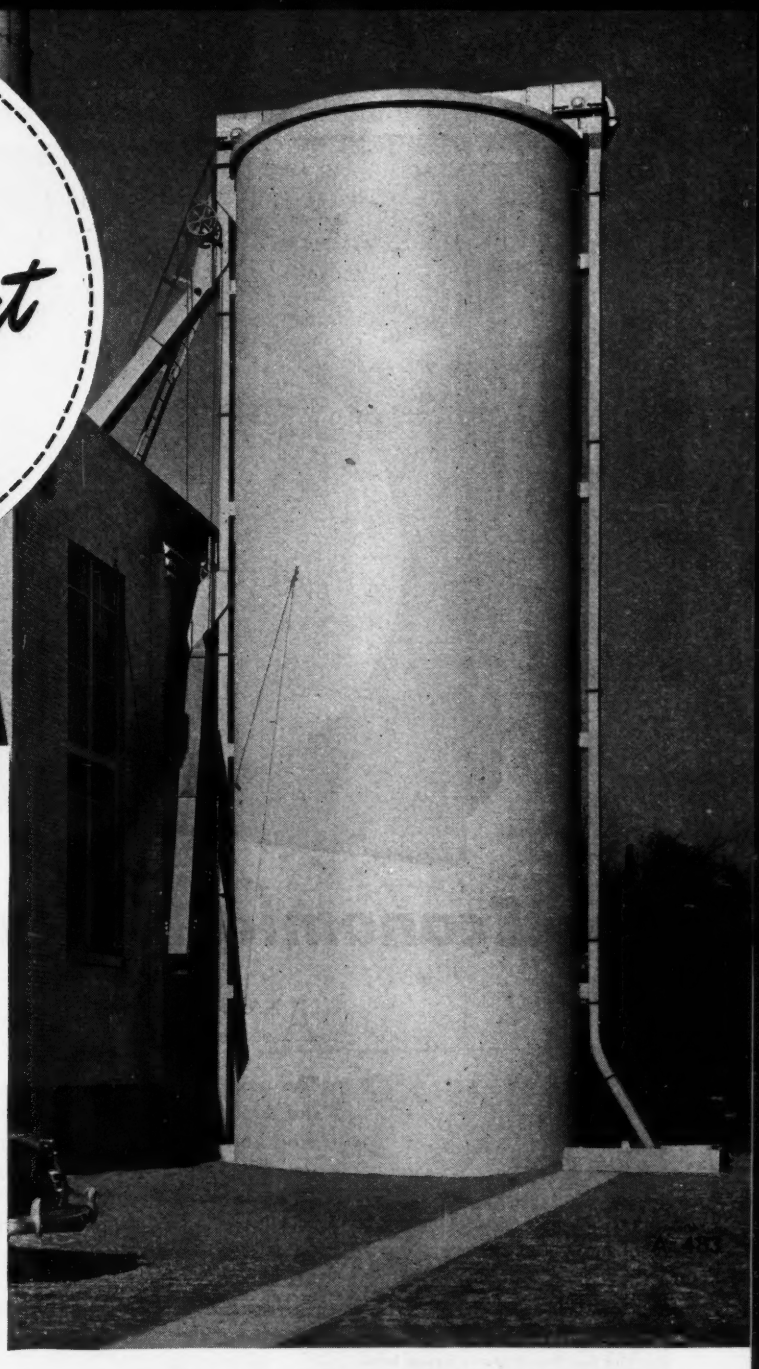
The key to the success of Stephens-Adamson coal and ash handling systems lies in the fact that this company can supply every element necessary to success.

Adequate equipment, all manufactured by S-A, of the exact type needed is available from S-A's broad line.

Competent engineering, the ability to assemble machinery units in a way to assure rapid and low-cost handling, is provided by skilled S-A engineers.

Valuable experience, gained in 43 years of specializing in material handling, serves to guide and direct S-A engineers at every planning stage.

Make these your reasons to consult S-A on your next handling job. Write us now.



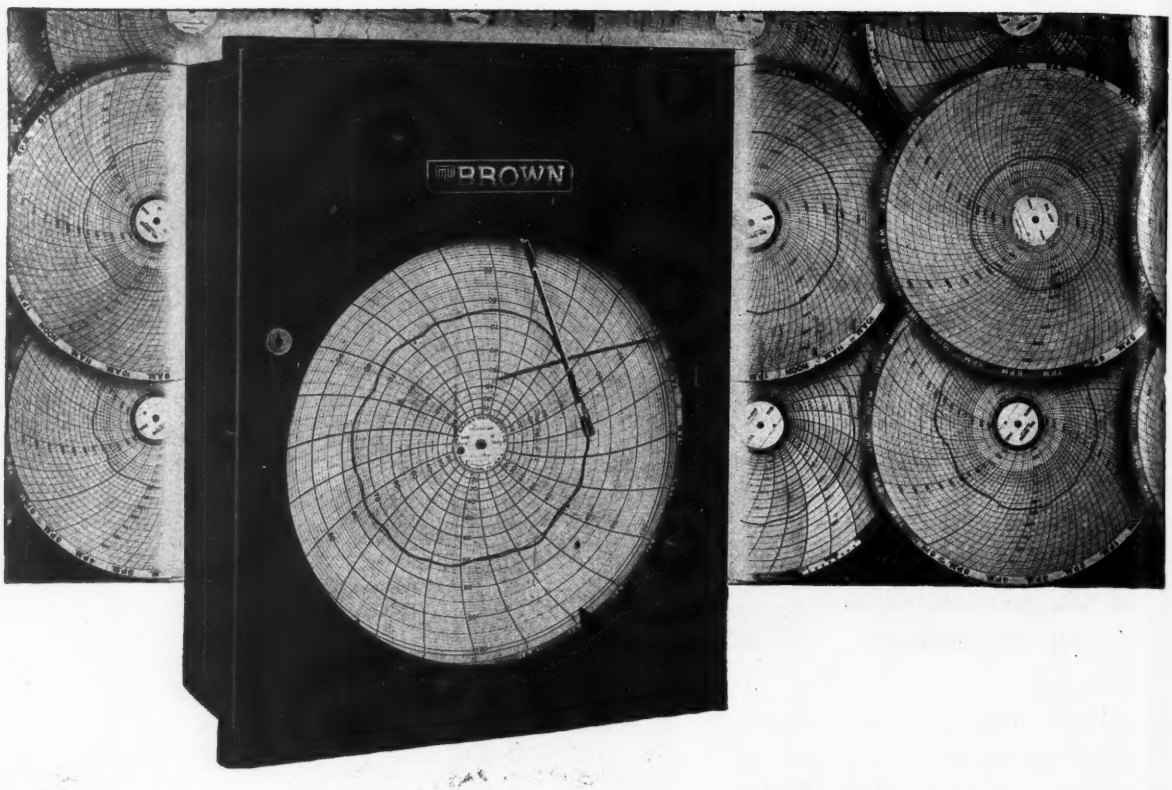
A vertical closed-circuit REDLER elevator completely encircles the above 300 ton storage silo. Coal is discharged into the top and reclaimed from underneath the silo. The chute from the REDLER elevator delivers coal directly to the boiler room. A long underground REDLER conveyor conveys coal from a distant track hopper to the right hand base of the silo where coal is transferred to the elevator.

STEPHENS-ADAMSON MFG. CO.

515 RIDGEWAY AVENUE, AURORA, ILLINOIS — LOS ANGELES, CALIF. ★ BELLEVILLE, ONT.

Designers and Manufacturers of All Types of

BULK MATERIAL HANDLING EQUIPMENT



How Economical is your Economizer?

Where to Use Brown Thermometers

Measure and Record:

Air Temperatures at preheaters
Flue Gas Temperatures leaving boiler
Gas Temperatures at preheaters
Gas Temperatures at economizers
Oil Temperatures at burners
Water Temperature at boiler inlet
Water Temperatures at economizer

AN economizer should live up to its name . . . that is, properly conserve heat energy of the boiler exit gases.

The more efficient the economizer, the lower your fuel bill will be. That the economizer is a means of reducing the cost of generating steam is well known to users of Brown Thermometers. Where they are installed, users have an accurate means of checking gas and water temperatures entering and leaving the economizer. The chart records enable them to attain maximum boiler operating efficiency.

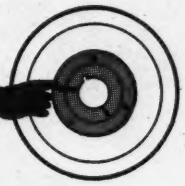
Brown Recording Thermometers measure temperatures ranging from —100° to +1000° F. in ranges suitable for power plant practice. Instruments can be supplied in one, two or three pen models.

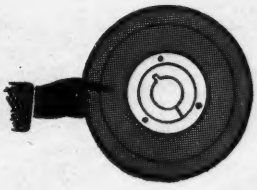
Brown Thermometers can be furnished with tubing as long as 200 feet. Brown Recording Pressure Gauges are available for operating pressures ranging from 30 inches vacuum to 10,000 lbs. per sq. in.

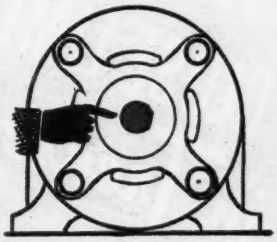
THE BROWN INSTRUMENT COMPANY, 4491 Wayne Avenue, Philadelphia, 44, Pennsylvania, a division of MINNEAPOLIS-HONEYWELL REGULATOR COMPANY, Minneapolis, Minnesota. Offices in all principal cities. 119 Peter Street, Toronto, Canada—Wadsworth Road, Perivale, Middlesex, England—Nybrokajen 7, Stockholm, Sweden.

Instruments by **BROWN** *and Controls by*

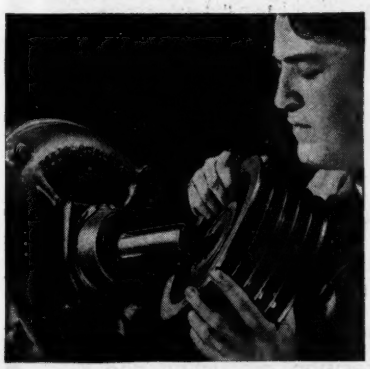
This locks this to this in 1 quick operation







Allis-Chalmers' new "Magic-Grip" with tapered split bushing is put on, aligned, locked to shaft *as a unit* — making it the fastest mounting and demounting sheave on the market!



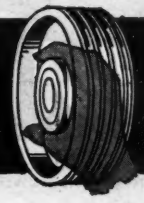
1 Place sheave on shaft. Slides on smoothly because clearance is provided by expanded bushing. There's *no* hammering — *no* forcing! Complete sheave and bushing unit comes intact—ready for quick, easy mounting.

2 Slide to desired position. Sliding easily, sheave can be placed *exactly* according to straight-edge . . . giving you true alignment with resulting smooth performance. A minimum of time is required.

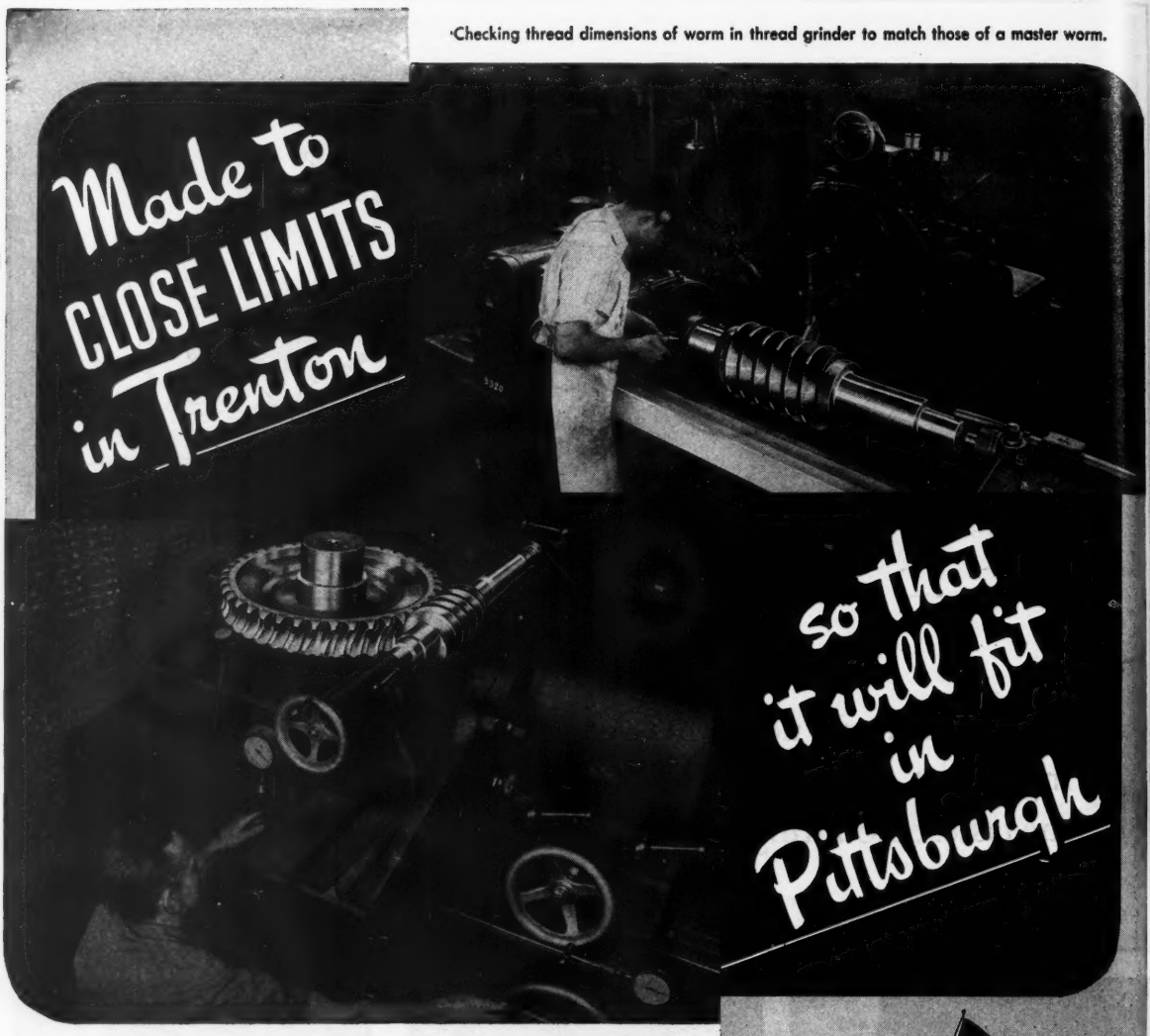
3 Tighten three capscrews — and it's ready to go! Entire sheave is locked securely to shaft and *grips like magic!* No set screws to damage shaft. Send for Bulletin B6310. Allis-Chalmers, Milwaukee 1, Wis.

A 1757

Allis-Chalmers Texrope "MAGIC-GRIP" SHEAVES



Checking thread dimensions of worm in thread grinder to match those of a master worm.



Checking tooth contact at exact center distance with worm center across gear, measurements being taken with a 1/10,000 inch dial indicator.

When you buy Worm Gear sets for building into your own machine tools, cranes, car loaders, conveyors, rolling mills, etc. you want to be sure that the parts are accurately machined to exact specifications and dimensions. Therefore specify DeLaval.

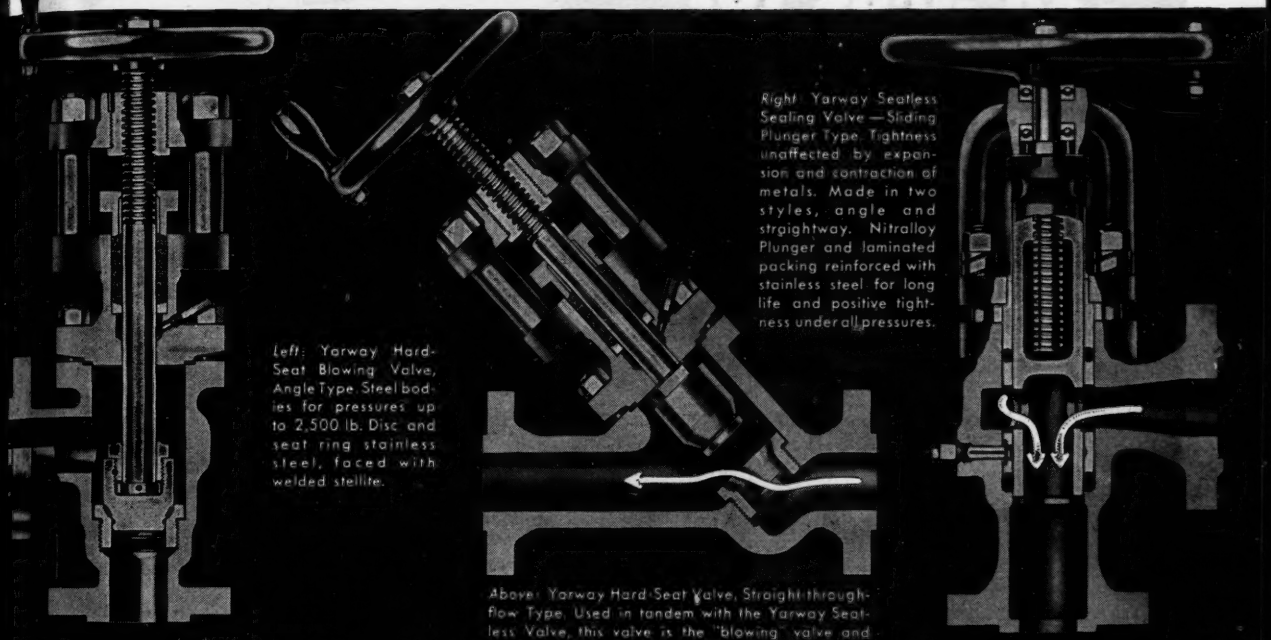
For the best results thread spacing on worms running at high pitch-line velocities must be accurate to within a few ten-thousandths of an inch. This degree of accuracy demands both precision production and precision checking.

M-28

De Laval Worm Gear Division
of the
De Laval Steam Turbine Co., Trenton 2, N. J.

MANUFACTURERS OF TURBINES . . . STEAM, HYDRAULIC; PUMPS . . . CENTRIFUGAL, CLOGLESS, ROTARY DISPLACEMENT, MOTOR-MOUNTED, MIXED-FLOW, PROPELLER; PRIMING SYSTEMS; CENTRIFUGAL BLOWERS and COMPRESSORS; GEARS . . . WORM, HELICAL, and FLEXIBLE COUPLINGS

For All High Pressure Blow-Down Requirements

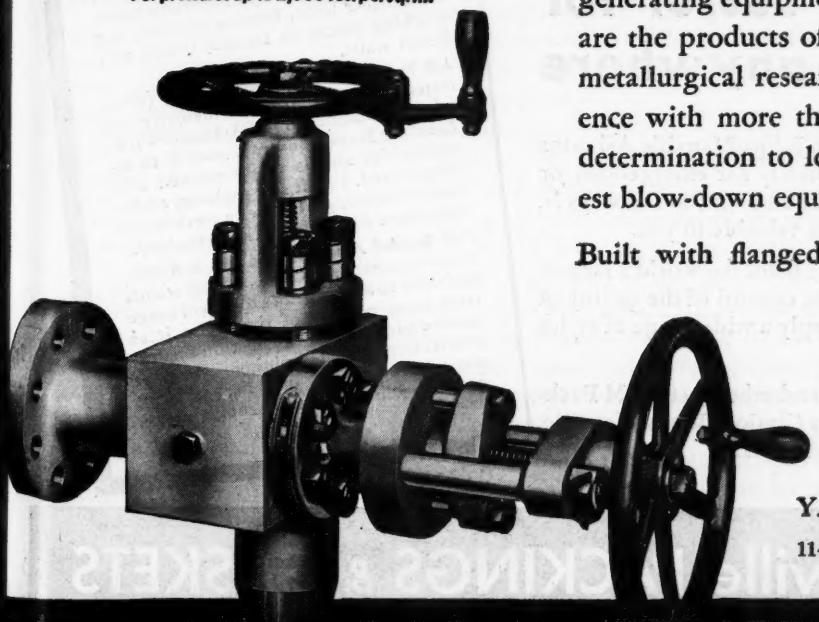


Left: Yarway Hard-Seat Blowing Valve, Angle Type. Steel bodies for pressures up to 2,500 lb. Disc and seat ring stainless steel, faced with welded stellite.

Right: Yarway Seatless Sealing Valve—Sliding Plunger Type. Tightness unaffected by expansion and contraction of metals. Made in two styles, angle and straightway. Nitralloy Plunger and laminated packing reinforced with stainless steel for long life and positive tightness under all pressures.

Above: Yarway Hard-Seat Valve, Straight-through-flow Type. Used in tandem with the Yarway Seatless Valve, this valve is the "blowing" valve and the Seatless is the "sealing" valve.

Below: **The Yarway Unit Tandem Valve—*equally suitable for blowing-down or draining and sealing*—combines a Hard-Seat and Seatless Valve in a single one-piece forged steel body. For pressures up to 2,500 lbs. per sq. in.**



Regarded as the standard of quality by outstanding steam plant designers and builders of steam generating equipment—Yarway Blow-Off Valves are the products of 35 years of mechanical and metallurgical research—of practical field experience with more than 12,000 installations—of a determination to lead the industry with the finest blow-down equipment that can be produced.

Built with flanged or welding ends for pressures up to 2,500 lb. Write for Catalog—Section B-424 for pressures up to 400 lb.; Section B-431 for higher pressures.

YARNALL-WARING COMPANY

114 Mermaid Ave. Philadelphia 18, Pa.

YARWAY BLOW-OFF VALVES

You'll find 1000 uses for these packings

J-M Wick and Rope Packings are useful for emergencies—*anywhere*

IT'S GOOD SENSE to have some Johns-Manville Asbestos Wick and Rope Packings handy for emergencies or for general use anywhere. There's no end to the ways in which these packings can prove valuable to you.

With its own source of supply from the world's largest asbestos mine, J-M has complete control of the quality of J-M Packings and is able to supply a wide range of styles to meet all needs.

For complete details on these and other useful J-M Packings, write for the J-M Packings Catalog. Johns-Manville, 22 East 40th Street, New York 16, N.Y.

3 TYPES

J-M Asbestos Wick Packing—twisted asbestos material that's easily handled and highly heat-resistant. Useful anywhere, especially for packing small valve stems on exhaust lines, heating systems; for caulking cracks in retorts, ovens, and boiler walls.

J-M Twisted Asbestos Rope Packing (illustrated above) is larger in diameter but otherwise similar to J-M Asbestos Wick. Asbestos Rope conforms readily to irregularities and is easily worked and compressed. Use it for packing, caulking or gasketing wherever a thicker material than Asbestos Wick is required.

J-M Braided Asbestos Rope has a firmer, more compact structure. It thus stands up better to abrasion and to severe usage over long periods of time. Use it as groove packing or for insulation on flexible or curved heated piping—wherever the use requires a dry, heat-resistant packing which can take rough usage.

JM PRODUCTS

Johns-Manville PACKINGS & GASKETS

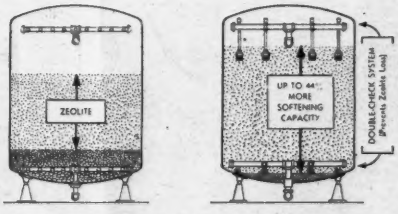
THERE'S A J-M DISTRIBUTOR NEAR YOU

No waiting FOR POSTWAR DESIGN IN WATER SOFTENERS

CAPACITY STEPPED UP 44% IN THE NEW ELGIN

Gives Up to 44% More Soft Water ● Prevents Loss of Zeolite ● Cuts Salt Consumption ● Assures Better Backwashing

IT'S THE ZEOLITE THAT DOES THE WORK



ORDINARY WATER SOFTENER DESIGN

ELGIN WATER SOFTENER DESIGN

WILL ALSO STEP-UP CAPACITY OF YOUR PRESENT WATER SOFTENER

If your problem is simply to step-up the capacity of your present softener, the "Double-Check" manifold arrangement is the answer. It can be installed quickly to replace the conventional manifold in any make water softener. This change, along with Elgin High-Capacity Zeolite will work wonders, and the cost of the whole job is surprisingly low. Write for facts.

YES, a long list of installations prove that we have "jumped the gun" in zeolite water softener design. Every one of the Elgin "Double-Check" Softeners in service is giving the kind of performance you would ordinarily associate with "postwar development"—up to 44% more soft water than could be obtained from the conventional zeolite water softener unit of equal size.

A basic change in manifold design accounts for this remarkable increase in capacity. The Elgin "Double-Check" manifold prevents the escape of zeolite—thus permits placing a far greater amount of water softening zeolite in the softener, as shown. Naturally, this means more output of soft water; for after all, it's the zeolite that does the work.

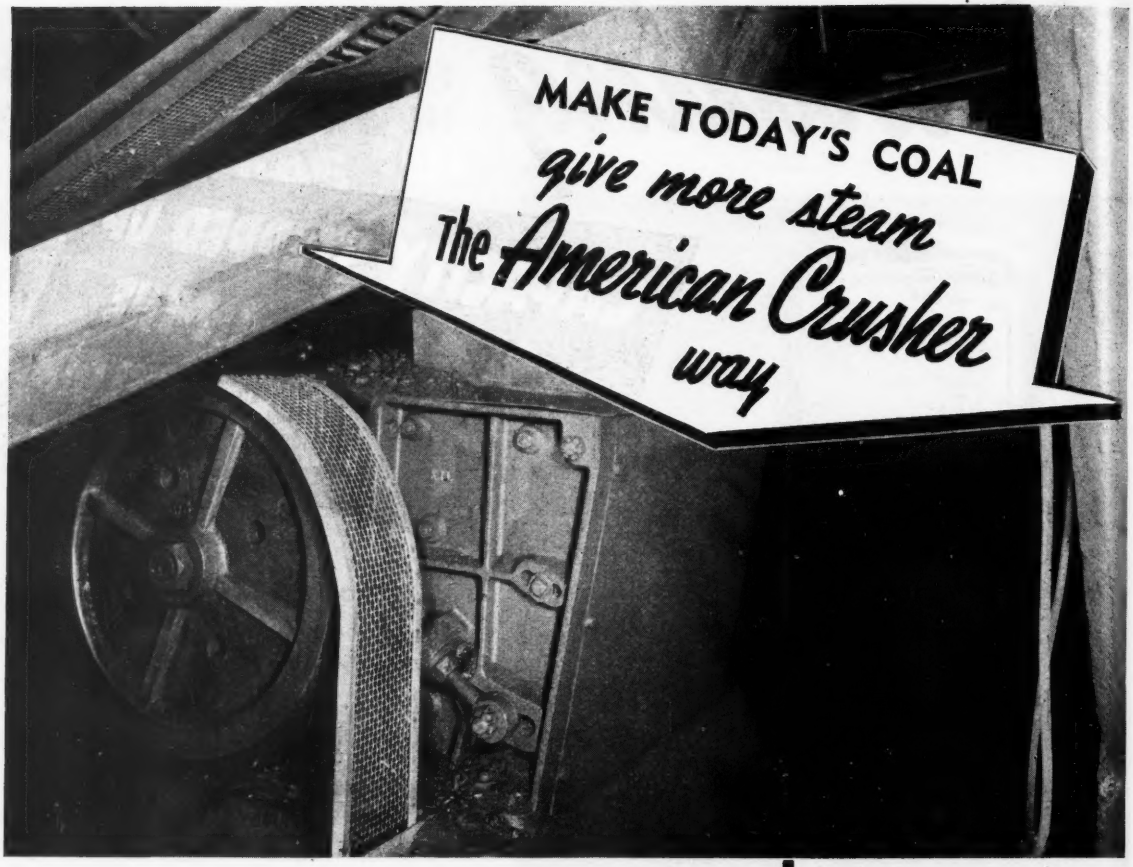
But that's only part of the story: The "Double-Check" manifold also assures better backwashing; keeps the zeolite clean, loose and uniform; prevents the common troubles of channeling and packing of the mineral bed. As a result, brine reaches every part of the zeolite, assuring far better regeneration and therefore higher efficiency that further increases soft water output.

All this is accomplished without loss of zeolite and with lower salt consumption. Ask for the new bulletin 603, which tells the whole story of "tomorrow's water softener today".

ELGIN ECONOMICAL WATER CONDITIONING

THE COMPLETE ELGIN LINE—Boiler Water Treating and Purifying Systems ● Feedwater Treatment ● Deconcentrators ● Heat Exchangers ● Water Softeners ● Filters and Purifiers ● Iron Removal Equipment ● Aerators ● Water Treating Chemicals ● Chemical Feeders ● Scale and Corrosion Inhibitors ● Sample Coolers ● Water Testing Equipment ● Zeolites

ELGIN SOFTENER CORPORATION, 136 North Grove Ave., Elgin, Illinois



How John Morrell & Co. plant saves through better preparation for Pulverized Coal Burning . . .

Regardless of the varying quality of the coal delivered to their bunkers these days, hundreds of plant operators find proper coal preparation a big help in holding down steam costs.

For example, the 24-30 AMERICAN Ring Crusher at John Morrell & Co., Ottumwa, Iowa (see picture above), reduces in one operation 50 t.p.h. bituminous coal 6 in. feed to ½ in. or under for pulverized fuel use.

Here, as with so many other users, the crushing to proper size with AMERICANS is done at a total cost of *less than a penny a ton*—including maintenance, power, labor, depreciation and interest on investment.

If you are anxious to get more steam from your present and future coal piles, ask our engineer to study your boiler plant operating conditions and offer suggestions for better coal preparation. Complete performance data, together with list of AMERICAN users in plants like yours will be sent on request.

Made in capacities from 25 to 500 t.p.h.
Also Laboratory-size Crushers.

Why Americans Never Clog Need NO Safety Devices

Patented manganese shredder rings (see above) in AMERICAN crushers split the coal and prevent clogging. Each ring has 20 cutting edges and maintains its outward position by centrifugal force. Because these rings are free to swing out in position, they are readily deflected when coming in contact with tramp iron. No safety devices are necessary, therefore, to protect the equipment.

AMERICAN PULVERIZER COMPANY
1429 Macklind Avenue
St. Louis 10, Missouri
ORIGINATORS AND MANUFACTURERS OF RING CRUSHERS AND PULVERIZERS

COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company — "Bridgeport" BRASS CO. — *Headquarters for BRASS, BRONZE, and COPPER*

Protective Scales Retard Corrosion in Condenser Tubing

The wide difference in corrosiveness of waters in various localities or even in the same vicinity, is due largely to variations in protective scale formation. In addition, certain waters may be much more corrosive during the summer due to seasonal excess of carbon dioxide which either prevents the formation of protective carbonate scale or dissolves existing carbonate scale.

Scale Formation Can Be Controlled

While some protective scaling is desirable, heated hard waters in certain localities produce calcium carbonate coatings so rapidly that the inside diameters of pipes are reduced considerably in a short time.

The low calcium content of soft water will not permit the formation of a protective carbonate scale, and allows corrosion to continue unchecked. In such instances one must depend upon:

1. Protective influence of the corrosion product of the metal or alloy involved or
2. The addition of lime, sodium silicate, etc. to the water to counteract the corrosive effect of dissolved carbon dioxide (CO_2).

Soft waters may lead to general and localized dezincification of low copper brasses such as Muntz metal and yellow brass.

Hydrogen Ion Concentration Influences Scale Formation

The hydrogen ion concentration (pH) in water together with other factors determines the probable formation of a protective coating of a mineral or mixture of mineral-corrosion product deposited on the metal surface. In the pH range from 6.8 to 9.3 the solubility of calcium carbonate in water ranges from approximately 15 to 350 parts per million. The calcium carbonate equilibrium point is where a given water will neither dissolve nor form solid calcium carbonate. In actual practice, the calcium carbonate equilibrium point is obtained by determining the pH and alkalinity values at which the water just ceases to act on powdered marble. In connection with this, it is also necessary to have as reference values the alkalinity and pH of the water before it acts on powdered marble.

Common Fresh Water Treatments

It is a common practice to add an alkali such as sodium hydroxide, soda ash, or lime to a soft water to neutralize the free carbon dioxide with the formation of a bicarbonate as indicated in the following:

Lime reacts with carbonic acid to yield calcium bicarbonate and water. The chemical expression describing this reaction is:

$$Ca(OH)_2 + 2H_2CO_3 \leftrightarrows Ca(HCO_3)_2 + 2H_2O$$

Carbonic acid (H_2CO_3) forms when atmospheric carbon dioxide (CO_2) reacts with water (H_2O):

$$CO_2 + H_2O \leftrightarrows H_2CO_3$$

For example, a corrosive natural water with an alkalinity value of 50 parts per million and a pH of 6.0 can be treated so that a pH of 8 or more is attained, which may place it in the scale forming classification.

The results of many years of corrosion research together with engineering data, specifications, and other information are published in Bridgeport's 112-page Condenser Tube Manual, which is free for the asking. Be sure to write for a copy.

★ ★ ★ ★

DUPLEX TUBING

Bridgeport's Duplex Tubing was developed for corrosive conditions too severe for a single metal or alloy. Such a condition is treated as two separate corrosion problems. The metals best for each are selected and combined by a drawing process which produces close mechanical contact.

Bridgeport's Duplex Tubing has many applications. One is in ammonia refrigeration systems where steel pipe rusts away from contact with water, and where copper will not withstand moist ammonia. In this connection, Duplex Tubing composed of steel for the ammonia side and copper or a copper base alloy such as Cuzinal, Admiralty, Cupro-Nickel, or Duronze IV, for the water side has been very successful. Other applications call for the following combinations:

Bridgeport Admiralty, Cupro-Nickel, Red Brass, Cuzinal, Copper or Duronze IV combined with such metals as carbon, steel, stainless, aluminum, or Monel metal.

The Bridgeport Brass Company has published a new Technical Bulletin on the applications and installations of Duplex Tubing which is available for the asking.

Note: Bridgeport products are supplied in accordance with existing priority regulations.

BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN.

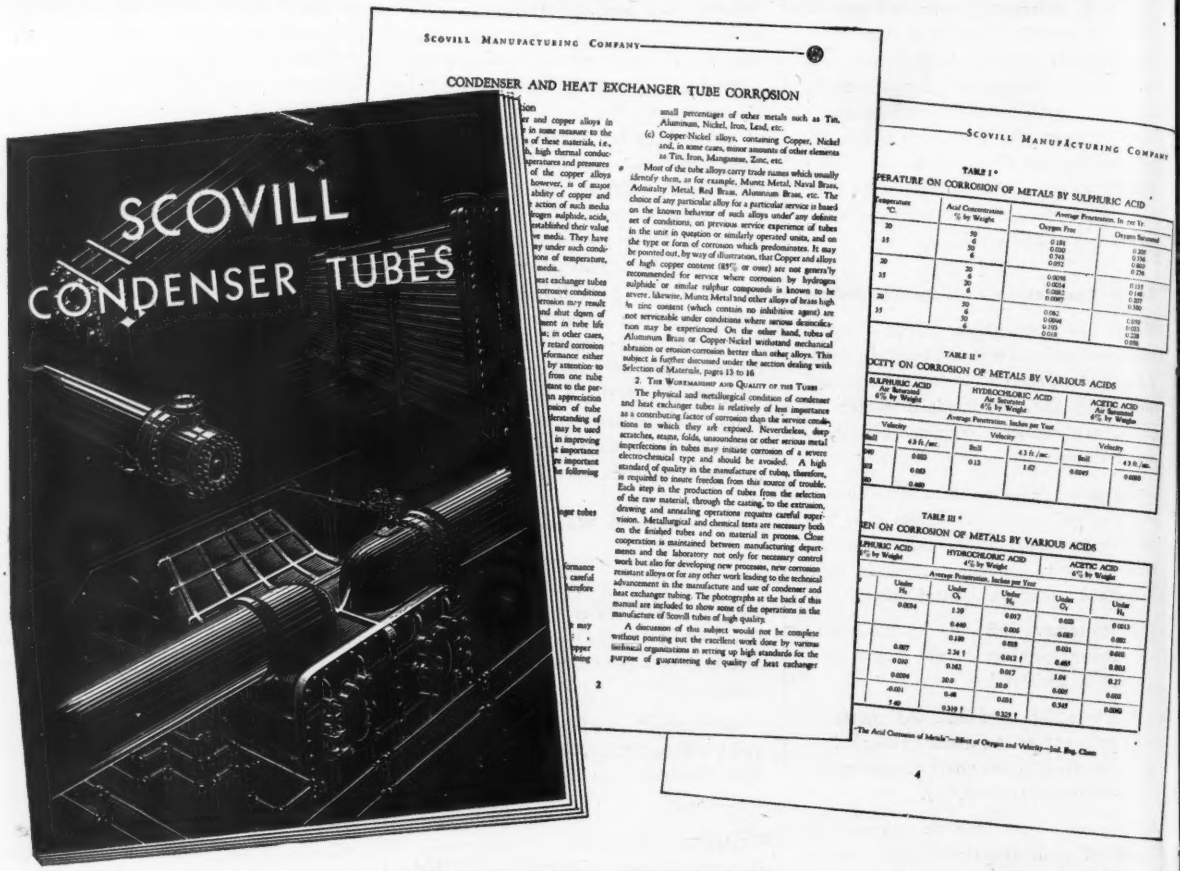
ARMY E NAVY

ESTABLISHED 1865

Scovill Tube News

Vol. 2 SCOVILL MANUFACTURING COMPANY, Waterbury 91, Conn No. 5

New Scovill "Condenser Tube Booklet" Gives Facts On Selection, Installation



Corrosion

The booklet has a color illustrated section on corrosion, as it affects condenser and heat exchanger tubes. Gives the factors that influence tube life — from alloy composition to service conditions. Discusses the six important types of tube corrosion and the corrodants involved. Amplifies on *stress, season* and *corrosion-fatigue* cracking.

Composition of Tube Metals

A separate chapter deals with the composition and physical properties of tube metals such as: Muntz Metal, Admiralty Metal, Phosphorized Admiralty, Red Brass, Deoxodized Copper, Arsenical Copper, Aluminum Brass, 70–30 Copper-Nickel, and 80–20 Copper-Nickel. It gives their nominal composition and the when, why and where of their use in condenser-tube and heat-exchanger fields.

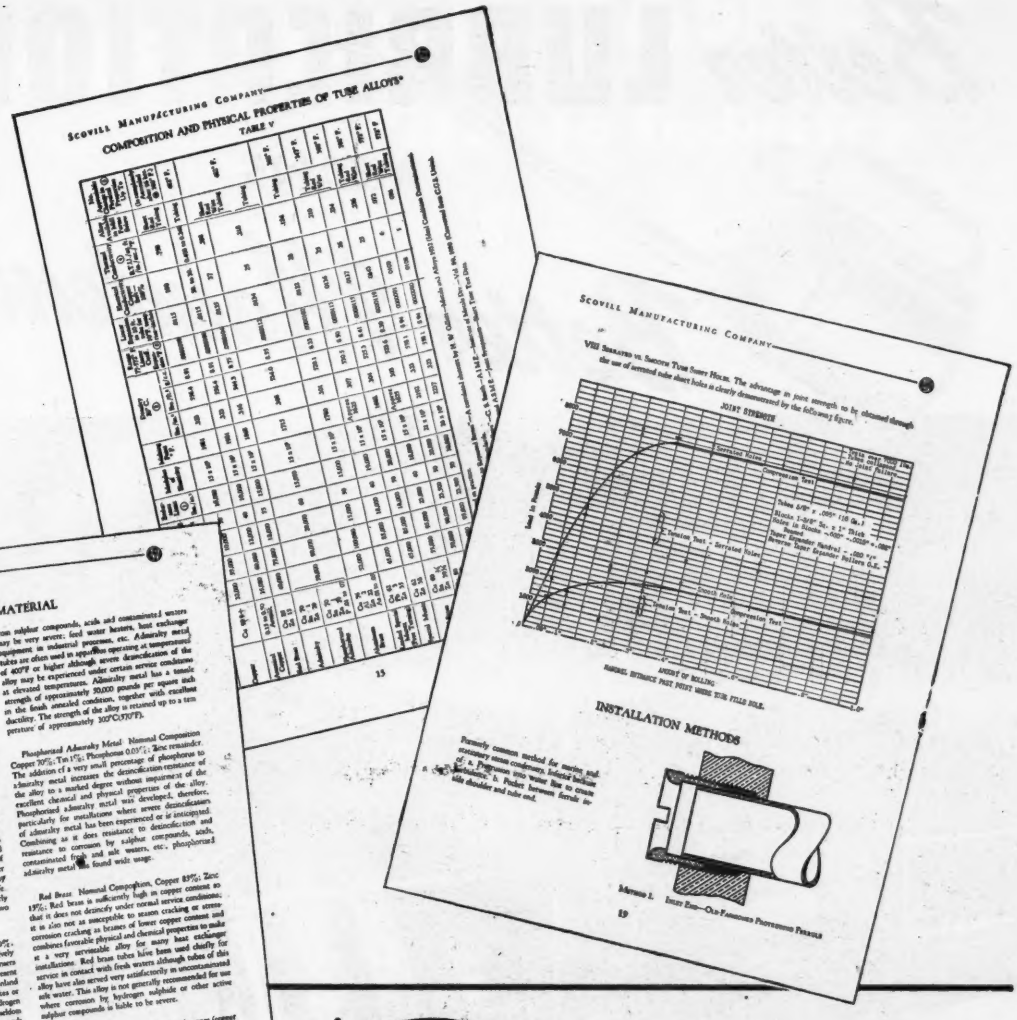
In this new booklet of tube facts, Scovill engineers have compressed a brief of many years of tube experience into some 56 pages. The result is a practical and understandable handbook that tube users will find useful.

Tube Installation

Another section concerns the importance of proper installation, methods of installation, the proper tools. Adequately illustrated with photographs, diagrams, charts and data tables.

Production Methods

Scovill explains the detail of the processes used in tube manufacturing. Thirteen full-page photographs give a good understanding of these processes.



ARMY E NAVY

THIS IS NUMBER ELEVEN in a Series of Scovill Advertisements to help you get longer life from condenser and heat exchanger tubes.

In Conclusion

Scovill's new "Condenser Tube Booklet" provides useful reference pages on Gauge Sizes, Inch Conversion Tables, Temperature Conversion Tables, Per Foot Weights of Scovill Condenser Tubes, Weights of Common Scovill Alloys, Pertinent Formulas and Physical Constants, Heat Unit Terms and Definitions and Conversion Factors with their definitions.

Other Scovill Services

It is by means such as this that Scovill renders its *Service in Manuals*. Other Scovill services include *Service in Metals* and *Service in Men*. The first makes the complete laboratory facilities of Scovill available for the determination of the alloy best suited to your needs. The latter gives you close cooperation from Scovill engineers in planning proper installation or investigation where necessary. Scovill Manufacturing Co., 17 Mill Street, Waterbury 91, Conn.

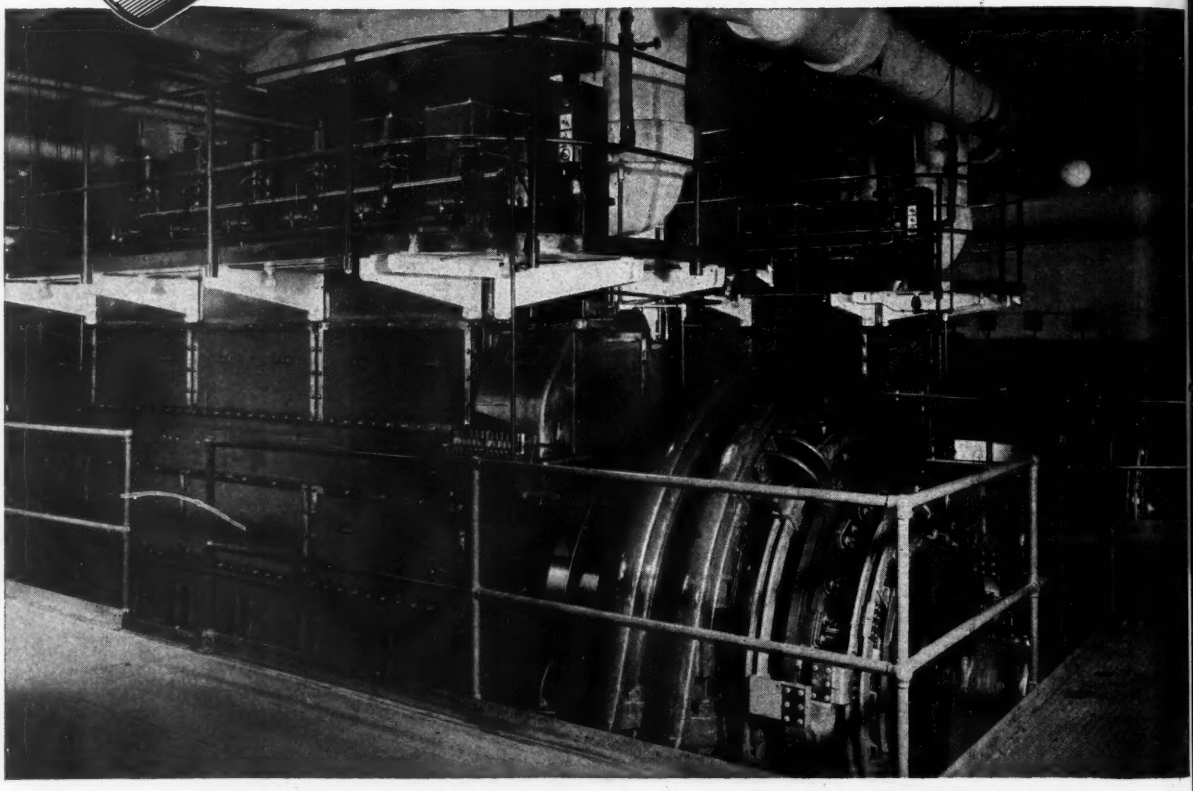
Scovill
MANUFACTURING COMPANY
WATERBURY, CONN.

SCOVILL CONDENSER TUBES

ONE PRODUCT... THREE SERVICES

Service in Manuals... Service in Metals... Service in Men

Better LUBRICATION MEANS *Better Maintenance*



• Excessive wear and difficult maintenance often result from inadequate lubrication.

Sinclair provides Rubilene and Gascon Oils for *better lubrication* of *DIESEL ENGINES.* They are non-corrosive, sludge-resistant, and assure complete power seal . . . maintain safe lubricating film under continuous heavy duty operation.

• • •

(Write for "The Service Factor" — published periodically and devoted to the solution of lubricating problems.)

SINCLAIR INDUSTRIAL OILS

FOR FULL INFORMATION OR LUBRICATION COUNSEL WRITE SINCLAIR REFINING COMPANY, 630 FIFTH AVENUE, NEW YORK 20, N. Y.

From This Laboratory Come

FACTS ABOUT GASKETS

Vital to Industry

In the unique Goetze Research Laboratory, actual service conditions are duplicated to prove exact gasket characteristics required in modern equipment.

Higher pressures and temperatures necessitated this more accurate data on gasket yield stress and gasket factor. (In other words — what it takes to seal a particular closure and to keep it tight under specific operating conditions.)

A 600,000 lb Compression Testing Machine and a 2000 psi, 1000° F. Boiler are among the modern equipment employed, with accurate auxiliary equipment to determine not only initial gasket characteristics, but also changes that occur under normal and adverse service conditions.

Likewise the Goetze laboratory is equipped to study gasket raw materials for physical and metallurgical properties with particular reference to the effect of metal structure upon gasket performance.

Original data resulting from this research is available to interested engineers and designers of pressure equipment in a series of technical bulletins. If you wish to receive your copies of these bulletins regularly, write on your company letterhead, stating your position.

GOETZE GASKET & PACKING CO., Inc.
17 ALLEN AVENUE, NEW BRUNSWICK, NEW JERSEY

• NEW GASKET FILM AVAILABLE

See this Research Laboratory and other facilities of this highly specialized service to Industry — and hear Lowell Thomas, famous news commentator, describe them — in the new Kodachrome Motion Picture, "ONLY A GASKET." Available to employee groups, technical societies, engineering schools and other organizations. Write for full information.

Goetze for GASKETS

"America's Oldest and Largest Industrial Gasket Manufacturer"

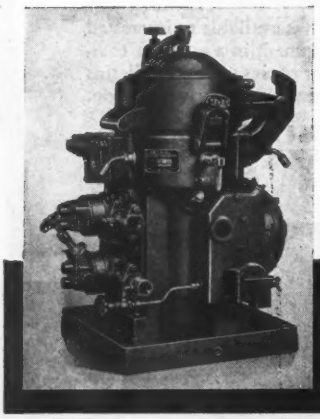
PURIFIED LUBRICATING OIL

TIME was when the old water wheel supplied power and little thought was given to lubrication. Today's turbines and engines, however, not only demand lubricating oil refined to exacting specifications; they also require that the highly refined oil be kept free from impurities which would impair its lubricating efficiency. De Laval Centrifugal Purifiers provide the most positive means of maintaining the oil in proper condition.

De Laval Oil Purifiers utilize centrifugal force to remove instantaneously the impurities normally collected in service—water, sludge, dirt, and other foreign matter. The De Laval disc type bowl so completely removes these impurities that the constantly purified oil performs at full efficiency over an indefinite period.

Bearings and other vital engine parts are given utmost protection and more dependable power plant operation is secured.

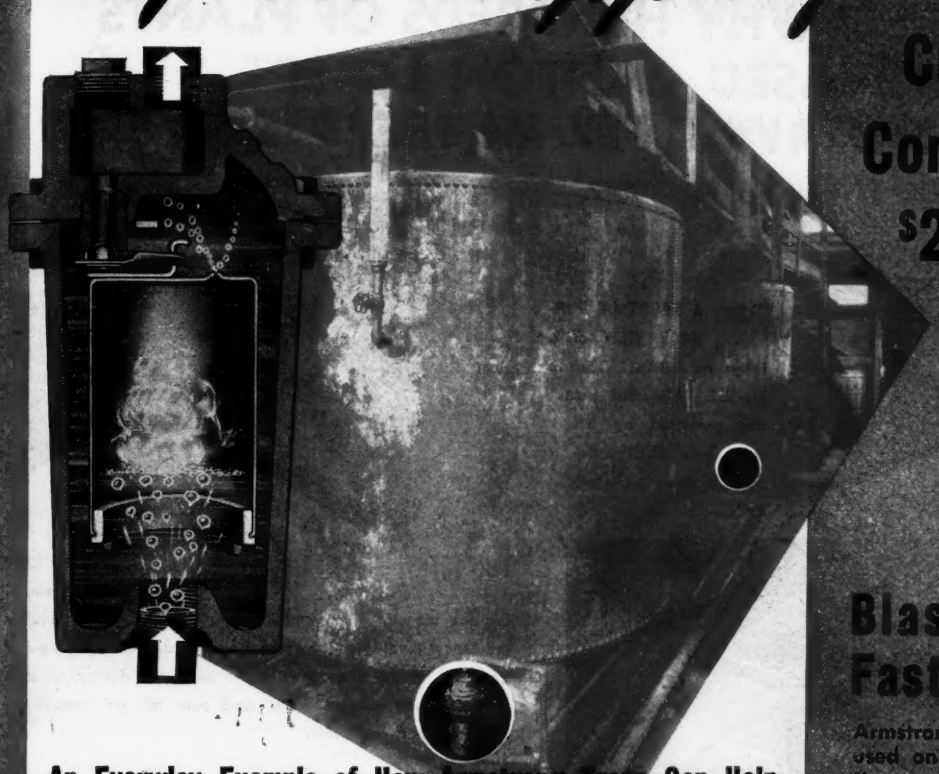
Write for additional details, sent without obligation.



THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 — 427 Randolph St., Chicago 6
DE LAVAL PAC FIC CO., 61 Beale St., San Francisco 19
THE DE LAVAL COMPANY, Limited
MONTREAL PETERBOROUGH WINNIPEG VANCOUVER

DE LAVAL OIL PURIFIERS

Complete Trapping . . . of Stills Cuts Fuel Consumption $25 a Day



An Everyday Example of How Armstrong Traps Can Help U.S. Through Crisis in Fuel, Materials, and Manpower

The chemical company in question unit trapped each of 17 stills with Armstrong No. 215 traps and secured fuel savings that returned the cost of the installation within a month. But what is even more important today than the monetary return is the saving in manpower, fuel and materials and the possibilities of increased production.

Every engineer knows that *condensate* and *air* are the foes of efficient utilization of steam, yet these simple facts cannot be repeated too often!

Armstrong Traps remove all condensate and air as fast as it accumulates without steam leakage. This means that the steam gives up its heat where it is supposed to! And the result is, as has been *proved* in thousands of installations, that efficiency is increased anywhere from 10% to 50% or more in extreme cases.

The ability of Armstrong traps to do a complete trapping job is inherent in the inverted bucket design and Armstrong construction. Heat treated, ground and lapped chrome steel valves are steam tight. The valve is either open wide or closed tight so that wiredrawing common to partially open orifices is eliminated. Swirling action of condensate carries away ordinary dirt and scale — it cannot interfere with trap operation. Air passes through the vent in the bucket, collects at the top of the trap and is discharged with the condensate. Condensate is discharged regardless of temperature as soon as enough forms to sink the bucket.

These are some of the reasons why it pays to buy Armstrongs. Write for Catalog H, 3rd edition. It is a handbook of condensate drainage practice.

Blast Traps for Fast Heating . . .

Armstrong Blast Traps are widely used on low pressure heating or "up-and-down" process units where large amounts of air must be removed quickly to permit faster heating. The blast type traps differ from a standard trap in that the inverted bucket is equipped with an auxiliary air vent which is controlled by a flat disc mounted at the end of a rustless, thermostatic bi-metal strip. When steam is first turned on, this auxiliary vent is wide open. Air and water blow straight through until steam comes in and causes the bi-metal strip to bend upward closing the auxiliary vent. The trap then works the same as a standard trap.

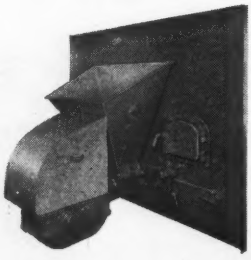
Thermic units can be supplied for any pressure. For high pressure process units, the auxiliary vent can be set to remain open to any desired temperature. Normally it is set to close at 212°. Capacity 50 to 100 times greater air venting capacity than the regular traps.

ARMSTRONG MACHINE WORKS, 810 Maple Street
Three Rivers, Michigan

ARMSTRONG · INVERTED BUCKET · STEAM TRAP

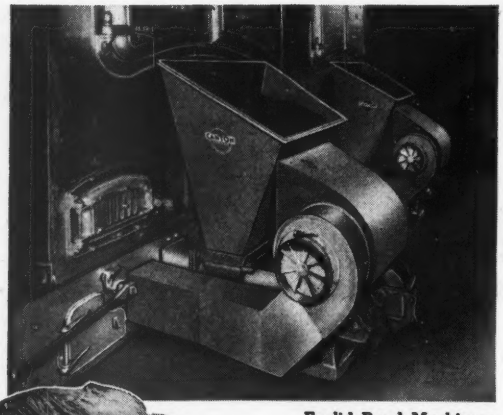
Armstrong

HERE'S WHY HUNDREDS OF PLANTS PURCHASED CANTON LO-SET . . .
THE HEAVY DUTY RAMFEED STOKER



A FRONT OF FURNACE VIEW of a fully assembled Canton LO-SET. All vital parts are protected by trim enclosures that add modern lines as well as safety.

SIDE FURNACE VIEW of Canton LO-SET installation showing the air slot arrangement in the Tuyeres. Coal burning efficiency is obtained by the gradual decrease in number and size of openings toward the side ash dumps, so that the fuel bed receives less and less air as combustion becomes more complete.



TYPICAL LO-SET INSTALLATION—Two Canton LO-SETS get high praise for maintaining ample steam pressure under all load conditions—no maintenance problems and fuel savings have topped expectations.

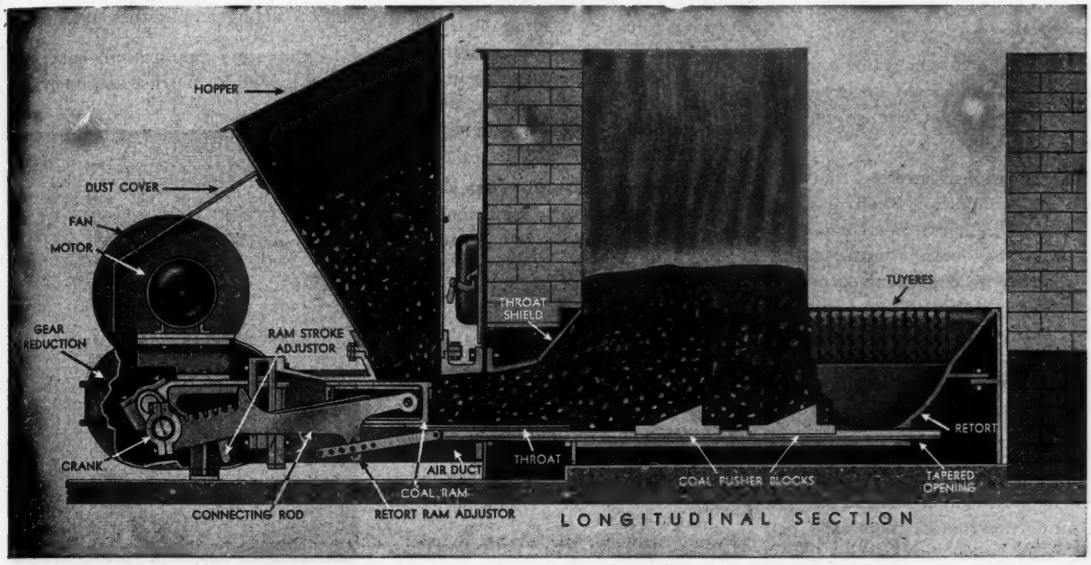
Euclid Road Machinery Co., Cleveland, Ohio

CANTON STOKERS

PARTICULARLY ADAPTED TO HIGH FIRE-BOX STEEL BOILERS

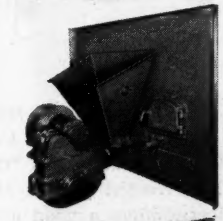
The LO-SET Stoker is one of Canton's 54 types and sizes for needs up to 800 H. P. Ruggedly constructed, it meets severe service demands. The firing efficiency means many dollars in fuel and manpower savings. Hundreds of schools, buildings, industrial plants, laundries, dairies, greenhouses, hospitals, hotels and other steam plants are experiencing LO-SET'S trouble-free performance . . . backed by Canton's FIVE YEAR GUARANTEE.

. . . AND HERE'S HOW YOU CAN MAKE LARGE SAVINGS IN FUEL — AND GET MAXIMUM EFFICIENCY!



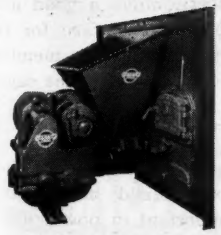
The longitudinal section view of a Canton LO-SET illustrates the feeding and coal burning method. Very little power is required as the gear reduction and drive are engineered to handle the maximum load easily — even wood, slate or small pieces of foreign matter are crushed and fed into the furnace without stoppage. Note the positive Ram Feed action and leveling blocks in the retort which distribute the fuel and help break up coke formations.

THE *Only* STOKER GUARANTEED 5 YEARS!



THE UNIFLEX DRIVE

Available for LO-SET installations is this compact drive arrangement designed for limited space. Note in photo (housing removed) the compact yet flexible assembly. The Uniflex provides independent stoker and fan control yet permits synchronized operation.



UNIFLEX STEAM DRIVE

Here's the same compactness as the electric Uniflex drive. Desirable where electric power is not reliable or if exhaust steam can be used advantageously for heating purposes.

SEND FOR COMPLETE DATA

FIVE YEAR GUARANTEE
The parties bound by this Contract, as described below, are the Canton Stoker Co
Pursuant to the above, the Company specifically agrees to replace, free of charge f.
this equipment, any part which may fail, wear out, or prove defective
This guarantee shall not

CANTON STOKER CORPORATION

900 ANDREW PLACE, S. W., CANTON, OHIO

Gentlemen:

---Please send all descriptive literature at once

---Have a CANTON Engineer interview us immediately

Name _____

Company _____

Address _____

City _____ **State** _____

THERMAL EXPANSION

and what it means when different metals must work together at various temperatures

Two metals, working in adjoining valve parts, obviously need similar thermal expansion properties.

Otherwise, the valve's operation and life would suffer, either from looseness and leakage when cold, or from galling and seizing when hot.

In such applications, therefore, thermal expansion is important chiefly in a *relative* sense. Whether a metal has a high or low rating doesn't matter so much as whether its coefficient corresponds reasonably well with that of the metal used in the adjacent part.

Thermal Characteristics of Inco Nickel Alloys

The INCO Nickel Alloys possess... in addition to their strength, toughness and corrosion-resistance... heat expansion properties that fit them especially for many power applications.

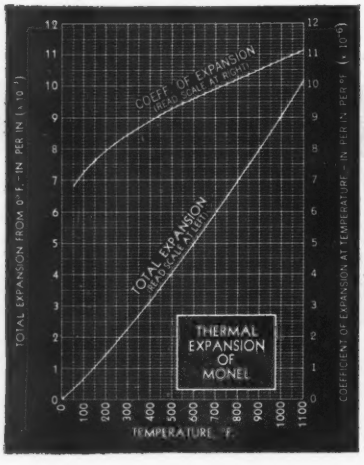
As a group, their thermal expansion about equals or slightly exceeds mild steel, and is somewhat lower than copper alloys. This in-between thermal expansion makes the high-nickel group especially suitable for parts which must maintain precision fits with *either* carbon steels or the brasses and bronzes, in valves and similar appliances.

Data on some of the alloys are shown in the accompanying charts.

What the Charts Illustrate

Each chart shows the total expansion in inches per inch when the alloy is heated from 0° F., to elevated temperatures. The net expansion in inches per inch is found by reading the difference between any two temperatures on the curve. The mean coefficient is found by dividing this net expansion by the number of degrees of temperature difference.

The upper curve of each chart, showing the instantaneous coefficient of expansion at various temperatures, provides a basis of approximate comparison from the standpoint of thermal expansion.

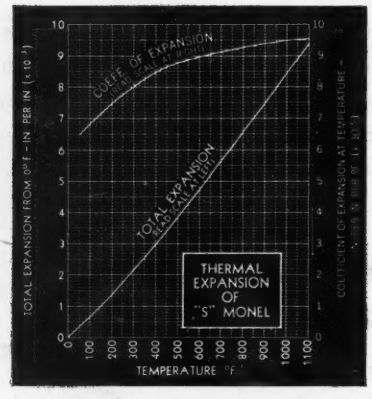

TOTAL EXPANSION FROM 0° F. - IN PER IN (x 10⁻³)
COEFF. OF EXPANSION (MEAN SCALE AT RIGHT)
TOTAL EXPANSION (INSTANTANEOUS SCALE AT LEFT)
THERMAL EXPANSION OF MONEL
TEMPERATURE °F.
COEFFICIENT OF EXPANSION AT TEMPERATURE - IN PER IN PER °F (x 10⁻⁶)

Practical Applications of Inco Nickel Alloys

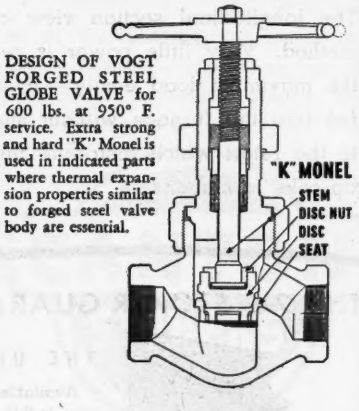
Two illustrations of high-nickel alloys in power applications are shown in conjunction with their corresponding charts.

In one instance, "K" Monel is used for the stem, disc, disc nut and seat of a forged steel globe valve, designed for 600 lb. at 950° F. service by the Henry Vogt Machine Co., Louisville, Ky. "K" Monel, in addition to being unusually strong and hard, has the necessary thermal expansion properties to assure good fit with the forged steel body under changing temperature conditions.

In the other application, cast "S" Monel is used for the disc and its cylindrical guide cage in a 12" cast steel valve, made by the Wm. Powell Co., Cincinnati, Ohio. Powell states "the 'S' Monel, heat-treated to 320-350 Brinell hardness, offers a good non-seizing, long-wearing surface for the disc, which is a free floating member, riding up and down within the cage".


TOTAL EXPANSION FROM 0° F. - IN PER IN (x 10⁻³)
COEFF. OF EXPANSION (MEAN SCALE AT RIGHT)
TOTAL EXPANSION (INSTANTANEOUS SCALE AT LEFT)
THERMAL EXPANSION OF "S" MONEL
TEMPERATURE °F.
COEFFICIENT OF EXPANSION AT TEMPERATURE - IN PER IN PER °F (x 10⁻⁶)

12" CAST STEEL toggle-operated non-return valve with welding ends for 1500 lbs. W.S.P. at 900° F. Disc (in foreground) and cylindrical guide are cast "S" Monel, heat treated to 320-350 Brinell for durable non-seizing service.



DESIGN OF VOGT FORGED STEEL GLOBE VALVE for 600 lbs. at 950° F. service. Extra strong and hard "K" Monel is used in indicated parts where thermal expansion properties similar to forged steel valve body are essential.

* * *

For additional information about Thermal Expansion... and about other properties important in power applications... write for "The Technical Editor Speaks". Address:

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL STREET, NEW YORK 5, N. Y.

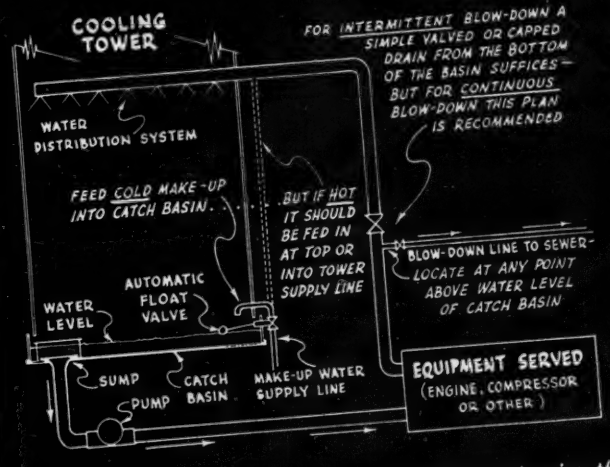
Cooling Tower DOs and DON'Ts
-by MARLEY (No. 4 of a series)

"MAKE-UP" AND WATER TREATMENT

The amount of "make-up" water required by a cooling tower is determined by the total of "evaporation loss", "drift loss" and "blow-down".

Evaporation loss seldom exceeds 1% of the amount of water circulated for each 10° F the water is cooled. Drift loss is that water carried out of the tower as fine droplets entrained in out-going air, usually less than 0.2% in mechanical draft towers having efficient drift eliminators but from natural draft deck towers and spray towers drift may lose as much as 1% to 3% of the water circulated. Blow-down is the continuous or intermittent removal of a part of the tower's circulating water to properly control concentration of chemicals in the water.

- If warm water is used as make-up, introduce it at top of tower; if cool, into catch basin.
- When planning make-up and water-treating facilities, make certain of adequacy at peak load.


COOLING TOWER
WATER DISTRIBUTION SYSTEM
FEED COLD MAKE-UP INTO CATCH BASIN.
BUT IF HOT IT SHOULD BE FED IN AT TOP OR INTO TOWER SUPPLY LINE
FOR INTERMITTENT BLOW-DOWN A SIMPLE VALVED OR CAPPED DRAIN FROM THE BOTTOM OF THE BASIN SUFFICES— BUT FOR CONTINUOUS BLOW-DOWN THIS PLAN IS RECOMMENDED
BLOW-DOWN LINE TO SEWER— LOCATE AT ANY POINT ABOVE WATER LEVEL OF CATCH BASIN
WATER LEVEL
AUTOMATIC FLOAT VALVE
SUMP PUMP
CATCH BASIN
MAKE-UP WATER SUPPLY LINE
EQUIPMENT SERVED (ENGINE, COMPRESSOR OR OTHER)

For any of the following conditions, consult a reliable water treatment engineer:

SCALE—In practically all water some scale-forming materials are found. Although sometimes troublesome in cooling towers, their greatest menace is to the equipment served, where scale deposits restrict water passages and reduce the heat transfer rate. Scale is controlled by "softening" or otherwise treating the water.

SOLUBLE SOLIDS—Concentration of soluble solids in cooling tower circulating water will raise the effective wet bulb temperature, thereby raising the temperature of the water leaving the tower. It may also cause sludge deposit in the system and corrosion of metals. Proper blow-down is a simple, effective control.

- Severe corrosion of steel towers or parts may be due to acid condition of the circulating water.

ALGAE—Uncontrolled organic matter, such as algae, can clog piping and spray nozzles, prevent proper water distribution and uniform fall through the filling, restrict suction through the sump, and collect in the equipment served until water flow and heat transfer are stagnated. Any of several common and inexpensive algaecides are effective against this nuisance.

DO YOU KNOW— that Marley pioneered and perfected the elimination of "drift" from mechanical draft towers with this patented triple-effect DRIFT ELIMINATOR. Frames of "Presite" composition are slotted to hold the Redwood blades into easily-removable "bundles," without rigid fastenings of any kind. Blades are kept in precise alignment and spacing, yet are free to expand and contract without warping or stress . . . maximum moisture-stoppage with minimum resistance to air flow.

MARLEY COOLING TOWERS

44 A

THE MARLEY COMPANY, INC. · KANSAS CITY · KANSAS

YARWAY TRAPS
"Go to Penn"

In the new, highly modern Harrison Laboratory Building of the University of Pennsylvania, 30 little Yarway Impulse Steam Traps handle the condensate draining job for the entire building's steam facilities—heating mains, hot water service heater coils and live steam lines to laboratory benches.

The selection of Yarways for this newest Penn building, no doubt, was influenced by the satisfactory service of more than 100 Impulse Traps in use throughout the University.

The *small size* of the Yarway Impulse Trap—hardly larger than a pipe fitting—its *straight-through piping* connections, and its *light weight—requiring no special support*—make possible the trim, compact, well-engineered piping arrangement illustrated above.

But even more important—its *continuous discharge on heavy condensate loads* brings cold equipment up to temperature more quickly; its *intermittent discharge on light loads* gives greater sustained heating efficiency.

Have you investigated this trap about which more and more users say: "When we need additional traps, they will be Yarways." (*More than 300,000 have been purchased.*)

You may be surprised to learn that it will *cost no more* to replace with Yarways *than to repair old, ordinary traps.* It's often the case, so why not get Yarway performance for your money?

Ask for Bulletin T-1738, or see your local Mill Supply Dealer.

YARNALL-WARING COMPANY • 114 Mermaid Ave., Phila. 18, Pa.

YARWAY IMPULSE STEAM TRAP

WHAT LEADERS SAY

Opportunity for High Post-war Production

By PAUL G. HOFFMAN

WHEN THE WAR is won, the question will arise, can the resourcefulness and unity of purpose that produced unprecedented quantities of war materials be put to work in peacetime to provide a high production of the things people want to eat, to wear and to use—in other words, to provide a high standard of living for the people?

In the year 1940, some 46,600,000 people were gainfully employed in our working-fighting forces. To provide a satisfactory level of production and employment, it will be necessary to increase the number of postwar jobs by many millions over 1940. The figure named by Philip Murray, President of the Congress of Industrial Organizations, is 9,000,000. The Brookings Institution recently estimated that 8,000,000 more jobs would be required. The Committee for Economic Development puts it at somewhere between 7,000,000 and 10,000,000.

Some people are fallaciously figuring that to solve this problem, there must be a gradual reduction of the work week to 30 hours or thereabouts. But we cannot have the things we want to eat and wear and enjoy except as a result of productive work.

But in addition to the fallacy that shortening hours is in itself a cure-all for all postwar problems, there are a number of others:

(1) That V-Day is a long way off and therefore we will have plenty of time to prepare for the problem which peace will bring.

(2) That reconversion will quickly take care of all of our troubles.

(3) That postwar planning is the exclusive province of manufacturers and industrialists.

(4) That postwar planning is an exclusive function of *big* business.

(5) That we can get along with the present *number* of businesses.

Careful analysis shows beyond a doubt that all of the above assumptions are incorrect and should be eliminated from business thinking.

The Committee for Economic Development starts with the above premises, positive and negative. It is an independent, non-governmental, non-political, self-financed body of businessmen, with a board of 22 trustees, 12 regional chairmen, approximately 100 district chairmen and more than 1,800 community chairmen. There are two main divisions:

(1) **The Field Development Division** gathers, from all possible sources, helpful information on postwar planning, and disseminates it to America's employers. Experts in manufacturing, marketing, sales, finance, management and engineering are pooling their knowledge and making it available to expert writers who can tell the story in an understandable way to all business.

The Field Development Division's work is carried on through direct contact with the largest corporations, through trade associations, and through local C.E.D. committees. Sixteen months ago there were 3 such committees operating in the United States. Today there are 1,807, with top-flight leaders collaborating with existing business organizations.

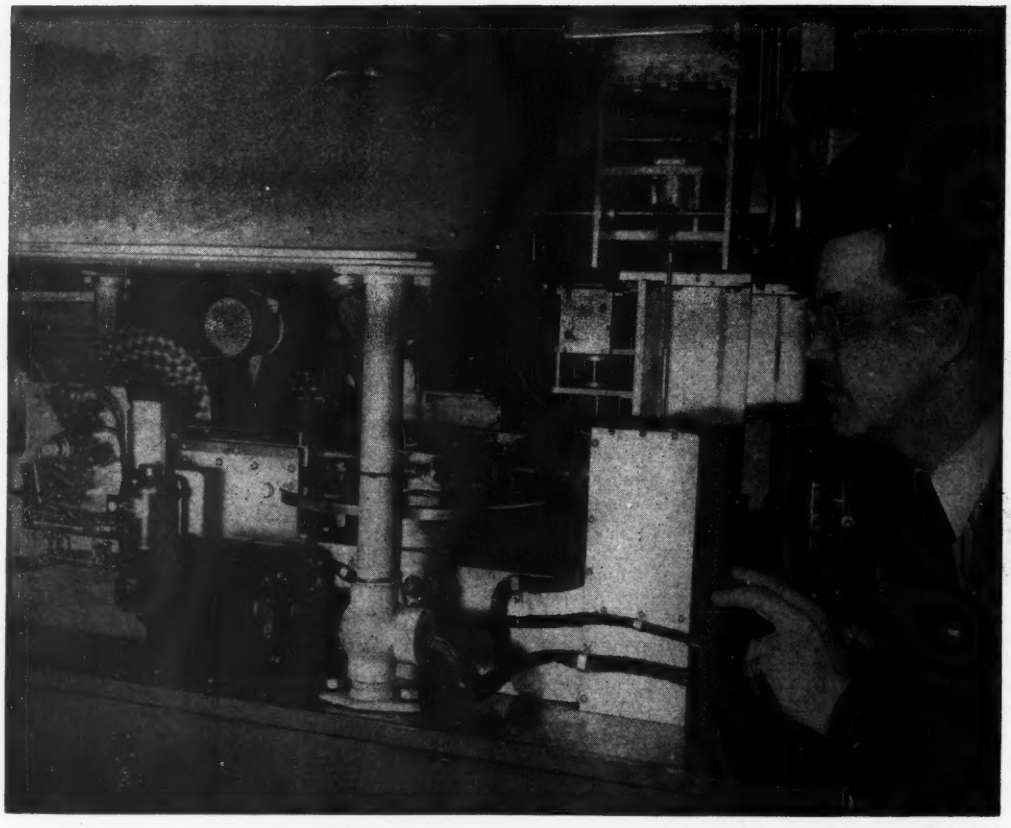
(2) **The Research Division** has a staff composed of leading economists and scholars, studying such problems as contract termination, disposal of government-owned surpluses and government-owned plants, taxation, foreign markets and many others that are beyond the control of individual businessmen.

The set-up of this research division is unique in that while independence is guaranteed the scholars, they have the opportunity to consult with the businessmen and specialists of the Division as their study progresses.

At the end of the war, speaking generally, our supply of raw materials will be ample—some of them in greatly increased volume. Our plant facilities will be almost double those of the pre-war period. We shall have a peak supply of skilled production and management workers. We shall, indeed, face the necessity of rehabilitating and revitalizing our system of distribution, but this can be done. We shall have a pent-up demand for goods tremendous in volume, and by the end of 1944, an estimated $100 billion in individual savings. There is no material reason why we should not achieve an economy in which more people will have more than ever in our history.

But the intangibles will be crucial. National policies and conditions must be such as to encourage business expansion and risk-taking. Above all, businessmen must take the lead in planning realistically and boldly for a splendid future.

Paul G. Hoffman is president of The Studebaker Corp. and chairman of the Board of Trustees of the Committee for Economic Development, commonly referred to throughout industry and in these pages as CED. As head of this organization, Mr. Hoffman has devoted most of his time for the past two years to urging private industry to plan now for greatly increased peace-time production and employment after the war. In the above statement, prepared especially for POWER PLANT ENGINEERING through Business News Service, Mr. Hoffman outlines the objectives that must be attained to provide 7,000,000 to 10,000,000 more jobs than in 1940 and improve living standards



SUPER-GADGET

THIS STRANGE and bewildering array of wheels, shafts, gimmiks, tubes, gadgets and whatnots, which would turn Rube Goldberg green with envy, believe it or not, is being used here to test turbine nozzles. Looking at it, we don't wonder our so-called civilization seems to be cracking up. When it takes a collection of paraphernalia like this to test a simple thing like a turbine nozzle, what is the world coming to? So far, despite the fact that we have looked at the photograph long and intently, upside down and sideways, we have not even been able to find the turbine nozzle. It must be in there somewhere because the General Electric Co. says it is. It seems that turbine nozzles have to be super-streamlined if turbines are to achieve maximum efficiency and so, G.E. engineers have been using this super-gadget to test them. In this test compressed air, substituted for steam, is blown at various pressures through the nozzle sample and the machine measures, records and adds up energies at various points on the nozzle.

The man at the right (we suspect he, too, is looking for the nozzle) is T. M. Berry of General Electric, who had much to do with the development of this equipment. It was somewhat of a relief to learn that this machine was not developed primarily to test turbine nozzles. The heart of the unit is what is known as a polarized light servo-system. Servo-mechanisms or "follow-up" systems are used in many recording and control devices to amplify small forces or torques so that the motion of a heavily-loaded output mechanism will correspond closely to the motion of a very low-torque input element. The type of servo-mechanism shown here was developed to satisfy the needs of a calculating machine in which it was desired to control the motion of an output mechanism to correspond closely to the rotation of a small integrating wheel which rolls on the surface of a revolving turntable.

Further details of the machine are given on page 95. It has many applications besides the one referred to here. In a particular instance where it was used in measuring the speed of large rotating machines, an accuracy of 0.025 per cent was attained for primary shaft speeds up to 1300 rpm. Wide ranges of speed can be measured.

WITH THE EDITORS

◆ **War's Destruction**—The thing about war that impresses us most forcefully is its destruction. As we begin to emerge from this one, we are appalled at the figures representing, in dollars, or tons, or time and effort, the enormous amount of material that has been wasted. We think of the millions of tons of shipping and cargo that has been sent to the bottom of the oceans. We think of the great European cities in ruins, of factories and transportation systems destroyed, of the countless millions of pounds of chemicals that have gone into the explosives used. Finally, we think of the millions of lives that have been lost or otherwise rendered useless but strangely enough, except in those instances where personal relations or friends are involved, the loss of human life is thought about least. Human life continues to remain one of the cheapest and the most replaceable items on earth. It is not much of a factor except in political speechmaking.

◆ **The bright side**—Despite the destruction of men, materials and natural resources, the war leaves the world richer in knowledge, and that, in many ways, offsets the loss of materials. It has been variously estimated that this war has advanced our knowledge 50 to 100 years. This is particularly true of technical knowledge and development. Technical knowledge has developed at an unprecedented rate during the period of the war and this acceleration is bound to have far-reaching effects in the years following the war, indeed, even now, it is beginning to make itself felt in our very attitude towards the post-war world. Immense as post-war problems are, we regard their solution with a high degree of confidence because we have seen what men and nations have been able to do under great stress and necessity. In the technical field there are many developments that we, as civilians, already know of but there are many others that we do not know of that will be ready to be put to use when the war ends.

Some of the technical developments resulting from the war effort have probably been overemphasized from the standpoint of their post-war peacetime uses but the fact remains that these developments are there and only our ingenuity need limit our use of them. The least that we can do is to investigate their possibilities. The advance of some of these developments will be limited not by technical obstacles but by social, economic or political confusion. Television is an example of this type. Technically, good television is possible today; even the former short distance transmission limitation of pre-war days has been overcome and it would be perfectly feasible to transmit television programs throughout the country, but commercial obstacles remain to be solved before we can expect any large scale television development to materialize.

In many fields technical development during the war has made the solution of some of our economic problems easier. In our own field, for example, that of power generation and distribution, the war has shown us how to reduce the costs of equipment beyond points deemed feasible before the war. As pointed out in an address by D. C. Prince of the General Electric Co. before the AIEE several months ago, we have had generators and transformers so high in efficiency that we need expect no large increase in their efficiency after the war. When we build transformers with efficiencies of 99.5 per cent, it obviously leaves little to be done in the future, so far as efficiency is concerned. This does not mean, however, that we have come to the end of the road in those things. We can still make them smaller and can develop new materials to make them better in other ways than merely increase their efficiency. We are learning a great deal about how to make them. As we reach a point where a given piece of machinery can be standardized in some way, then it becomes possible to make a new set of advances which will reduce the cost of that machinery and thereby make it more available to mankind.

Some conspicuous examples of that sort are coming to light, as a result of the war effort. For the first time in history we have 30,000 hp steam turbines in quantity production. The result of that quantity production in terms of man-hours can be measured. After production had gone on 21 months it took only 71 per cent as many man-hours to produce such turbines as it had taken before.

◆ **What, No More Motors?**—Recent developments and applications in the field of electric motors furnishes another good example of the accelerating effect of the war upon what had become to be regarded as a rather prosaic branch of the electrical art. In 1929 it was reported that 79 per cent of manufacturing processes that could be electrified with motors were so electrified. In 1939, ten years later, that fraction had reached 86 per cent.

We cannot measure the use of motors by such ratios, however, because during that period the total amount of manufacture increased by a considerable degree. Furthermore, we are constantly discovering new uses for motors—things that we did not know about previously. An outstanding example of this is in the field of aeronautics. Originally the airplane had one engine in it and it had electric ignition. Except for a few landing lights the ignition system was the only place where electric power was used. Today, there are four motored bombers which have over 185 motors in them performing, different kinds of functions. With developments of that sort, as David Prince pointed out, it is useless to talk about saturation either in the number of motors or the use to which they can be put. We have new motors today as light as 25 lb for a 35 hp motor and others with rotational speeds as high as 120,000 rpm We have hardly begun to explore the uses of such motors.

These developments are mentioned here because they indicate the shape of things to come and show what sort of things we will have to think about in our post-war planning schemes. Post-war planning if it is to be effective, must be practical. It does not mean suddenly revolutionizing our plants and factories with new and strange electronic and plastic gadgets. It does mean carefully studying and analyzing each element of our systems to see where they can be improved, either in efficiency or cost or reliability, keeping in mind all the possibilities of the immense technical advance five years of war effort has made available to us.

◆ **Avoid all work**—One of the things the war has brought home to us as a consequence of manpower shortage is the great benefit inherent in labor saving equipment. Post-war planners will do well to keep this fact in mind. In power plants as well as in factories, the motorization of valves, the use of automatic control and protective devices will offer excellent means of reducing costs. In a recent article in Electric Light and Power, Philip Sporn, among many other things in connection with post-war planning, points out that the general adoption of the principle that no manpower should be used for a job that a chart or an integrator can perform, or that a small motor, solenoid, or control circuit will do, will yield an amazing harvest of labor and cost reducing projects. Many of these can be planned and prepared for now.

A number of excellent suggestions for post-war development on electrical systems are contained in the article in this issue by A. C. Montieth of Westinghouse Electric & Mfg. Co. Mr. Montieth urges the simplification of system layout and the reduction of component parts to a minimum.

◆ **Lt. Cols. at 30**—No appraisal of the possible effects of war developments upon future peacetime economy would be complete without some reference to the advances in educational methods. The development of countless scientific processes and equipments have made it necessary for those concerned with the developments to impart and communicate the techniques to others who have had little background in these fields. In the Army training courses, in just a few weeks' time, knowledge has been imparted to young men which has enabled them to do things which ordinarily they could not have done without taking a four year college course. Now, of course, there is nothing wrong with four year college courses for those who may need them but the war has made it clear that for many highly technical purposes short courses of instruction can prove highly adequate. If such short training courses prove adequate for war work there is no reason why similar courses will not prove equally effective in peacetime operations and part of post-war planning should be devoted to developing and extending such training courses, not only for developing competent technicians but also for developing capable leaders. As Mr. Prince points out in his address, we have only to look at the decorations on the shoulders and breasts of our men in service to learn that it is not necessary for a man to become 50 years old before becoming a competent leader. That, also, is one of the possibilities that will have to be considered by the people in charge of the educational phases of post-war planning.—A. W. K.

SHASTA—Key to Central Va

Central Valley Project in California designed to solve inter-related irrigation, salt water intrusion and flood problems . . . Shasta storage and power development most important feature in project . . . Details of concrete gravity dam, 3500 ft long and 600 ft high . . . Power house designed for installation of five 75,000-kw main hydro-electric generating units, two 2500-kw station service units; total generating capacity 380,000-kw . . . Details of units and auxiliaries . . . Generation at 13,800 v, transmission at 230,000 v.

SHASTA DAM and power plant, which are being constructed by the Bureau of Reclamation, were scheduled to be completed to such an extent that the production of electrical energy could begin in May, 1944. The plant is now generating power.

This development is the most important feature of the Central Valley Project, a multiple-purpose Federal undertaking designed to solve some of the long-standing problems of the Great Central Valley of California. When completed, the Central Valley Project will consist of many features, such as reservoirs, dams, power plants, transmission lines, substations, pumping plants, canals, and laterals. Some of these features, if constructed and operated alone, would produce some benefits, others little if any benefits, whereas when all are completed and properly coordinated, and each is performing the functions for which it is designed, many great benefits will be realized. The following brief description of the Great Central Valley, and of the Central Valley Project, will show the relation and importance of the Shasta storage and power development to the valley and to the project.

A panoramic perspective of the Central Valley Project is shown in Fig. 3.

Fig. 1. View in Shasta power house, showing initial installation of two 75,000-kw units

The Sacramento River rises near Mount Shasta, and the San Joaquin River rises in the Sierra Nevada Mountains near the Yosemite Valley. The Sacramento River flows south and the San Joaquin northwest to a point north of the center of the valley, where the two rivers converge to form a delta, and then flow west through a common mouth into Suisun Bay and thence into San Francisco Bay. This delta region is near Stockton, Calif.

Problems to be Solved in Central Valley

The irrigation problem arises from the fact that, while there is no shortage of rainfall in the Great Central Valley as a whole, the distribution of such rainfall does not correspond with the agricultural development. Two-thirds of the water comes from the Sacramento Basin and only one-third from the San Joaquin Basin, whereas two-thirds of the demand for irrigation water comes from the more fertile San Joaquin Basin, and only one-third from the Sacramento Basin. Also the rainfall and snowfall do not occur during the irrigation season but during the winter and early spring, and two-thirds of the total water escapes to the ocean during the nonirrigation season. The shortage of irrigation water in the upper San Joaquin Valley has already reached a critical point, and if not relieved will cause serious losses on about 400,000 acres of valuable and well developed farms located mostly in Tulare and Kern Counties, and to some extent in Madera County. This shortage of water becomes greater each year due to the increased diversions of irrigation water by up-stream water users, and the increase in orchard cultivation. Many new wells have been sunk to obtain irrigation water but the increased extraction of ground water without a corresponding increase in ground water supply has only resulted in other wells going dry or in lowering the water table, which in some areas is as much as 250 ft below the ground surface. About 40,000 acres of land have already gone out of cultivation.

The salt water intrusion problem arises because a reduction in the flow of the Sacramento River during dry years has permitted salt water from San Francisco Bay to penetrate the delta channels to such an extent as to damage or endanger 400,000 acres of highly developed farm

alley

By M. H. Kight
Electrical Engineer
U. S. Bureau of Reclamation

Fig. 2. General view of Shasta dam and power house, looking upstream during construction

lands in the above mentioned delta region. Several thousand acres of such land have already been ruined and additional acres are being ruined each year.

The flood problem arises from the fact that during short periods of certain years, heavy rainfall and melting snows in the Sacramento River watershed cause large quantities of unregulated water to rush through the Sacramento Basin causing the Sacramento River to overflow at many points and inflicting heavy damage in its path. Floods on the San Joaquin River do not cause so much damage because overflow occurs at very low stages and the excess water spreads out over extensive areas of pasture land.

Most of the problems in the Great Central Valley concerned primarily with irrigation, salt water intrusion, and flood control, and to a lesser extent with navigation and electric power production, can be solved by the construction of the various features of the Central Valley Project. These features, their location, and the function of each are as follows:

a. Shasta Dam and Reservoir—On the Sacramento River 12 miles north of Redding, as shown in Fig. 3, to store surplus water during the rainy season which can be transferred later on to the San Joaquin Valley for use during the irrigation season; to control the flow of water for the prevention of salt intrusion and floods, and the improvement of navigation; and to create a head for the production of power.

b. Shasta Power Plant—At the base of the Shasta Dam, to produce power for the operation of pumping plants to be constructed on the canals listed below, and for distribution and sale to others for domestic, commercial, and industrial uses.

c. Keswick Dam, Reservoir, and Power Plant—On the Sacramento River four miles above Redding—Same function as Shasta Dam and power plant except that the reservoir has such limited capacity that it cannot store surplus water for irrigation purposes, but merely acts as a re-regulating afterbay for the Shasta Power Plant, to permit that plant to serve as a peaking plant whenever necessary and yet maintain a fairly uniform flow of water in the Sacramento River below Keswick Dam.

d. Transmission Lines—As required for the transmission of electrical energy from the power plants to the pumping plants, to be constructed on the canals listed below, and to the various other points of use.

e. Delta Cross Channel and Pumping Plants—Canal will extend from the Sacramento River across the eastern edge of the above-mentioned delta to a point near Stockton. It will transfer surplus fresh water from the Sacramento River to the point where the San Joaquin River enters the delta, where it will be used to prevent the encroachment of salt water, and to supply water to the Contra Costa and Delta-Mendota Canals, which are in the San Joaquin Valley.

f. Contra Costa Canal and Pumping Plants—Canal extends from the delta region to the vicinity of Martinez, to transmit surplus fresh water from the Sacramento River to heavy industries, and to farms for irrigation purposes, in the area between Stockton and Martinez.

g. Delta-Mendota Canal and Pumping Plants—Canal will extend from a point near Stockton to a point near Mendota, to transmit surplus fresh water from the Sacramento River to a point near Mendota on the San Joaquin River. This water will replace the water to be diverted from the San Joaquin River at Friant Dam, and will be used for the irrigation of lands in the Northern part of the San Joaquin Valley.

Fig. 3. Panoramic map of Central Valley of California showing principal characteristics of Central Valley Project and relation of Shasta Dam to entire development

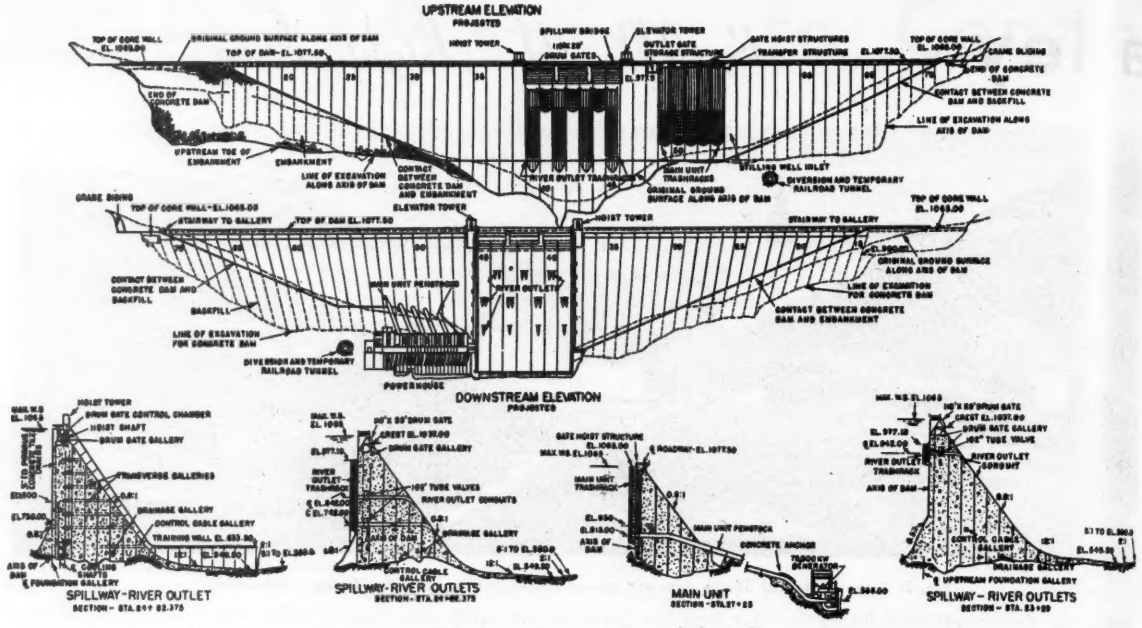


Fig. 4. Elevations and cross-sections of Shasta Dam

h. Friant Dam and Reservoir—On the San Joaquin River about 20 miles north of Fresno—Same function as Shasta Dam except to a much lesser extent and the production of power is not anticipated.

i. Madera Canal—Canal will extend from Friant Dam through Madera County to Ash Slough, to transmit water from the San Joaquin River for use in Madera County.

j. Friant—Kern Canal—Canal will extend from Friant Dam through Fresno, Tulare, and Kern Counties to Bakersfield, to transmit water from the San Joaquin River for use in those counties.

The functions of the various features of the Central Valley Project show that the irrigation features of the project are all dependent either directly or indirectly upon the Shasta storage and power development, but that full benefits from the project can be realized only when every feature has been completed and properly coordinated, and each is performing the functions for which it is designed. For instance, at the present time, the entire normal flow of the San Joaquin River is appropriated for irrigation purposes, and the holders of water rights on the lower San Joaquin River, who divert at Mendota Dam, will not permit the storage of water in the Friant Reservoir, for diversion into the Madera and Friant-Kern Canals, until such water can be replaced by the importation of water released from the Shasta Reservoir.

Shasta Dam and Reservoir

The Shasta Dam, including the earth and rockfill left abutment, is about 3,500 ft long on the crest, and about 600 ft high above the lowest point of the foundation. It is of the concrete gravity type with a straight overflow spillway section 375 ft long near the center of the dam, and with curved abutment sections. When completed, the dam will contain about 6,500,000 cu yd of concrete.

Flow of water over the spillway will be controlled by three 110-ft by 28-ft drum gates installed between piers on the crest of the spillway. Eighteen 102-in. diameter steel-lined outlet pipes are embedded in the concrete in the spillway section at three elevations 100 ft apart. The entrances to these outlet pipes are protected by trashracks, and the flow through each outlet pipe is controlled by a 102-in. tube type valve.

Five welded, plate-steel penstocks pass through the concrete in the right abutment to the turbine casings in the power plant. The diameter of each penstock varies from 15 ft at the intake end to 12 ft 8 in. at the downstream end. The entrance to each penstock is protected by trashracks on the upstream face of the dam. One emergency closure gate for each penstock is installed on the upstream face of the dam. These gates will be operated by means of hydraulic hoists, and will be maintained by the use of a 125-ton gantry crane which travels on rails on top of the dam.

Shasta Dam backs up the waters of the Sacramento, Pit, and McCloud Rivers for 35 miles, and forms a reservoir having a total capacity of 4,500,000 acre-feet. The top 500,000 acre-feet of reservoir capacity will be reserved for flood control, and the bottom 500,000 acre-feet will be assigned to dead storage. The dead storage elevation is such that the minimum net head on the turbines will be equal to 50 per cent of the maximum head.

Shasta Power Plant

The Shasta Power Plant is located a short distance downstream from the dam and on the right bank of the Sacramento River, which makes a turn of about 45 deg to the right immediately below the dam. The power house is of reinforced concrete construction, and is designed for an ultimate installation of 5 main and 2 station service generating units. The superstructure is 76 ft wide and 452 ft 10 in. long. The initial installation of equipment consists of 2 main and 2 station service generating units, and 2 banks of main transformers, complete with the necessary auxiliary and control equipment, and handling facilities. Daytime lighting of the building is obtained by the use of glass block panels in the generator room and station service bay and by metal-sash windows in the machine shop and control bay.

Main Cranes

Two 250-ton cranes are installed in the power plant. These are of the electrically-operated, indoor, overhead, traveling type, equipped with 2 trolleys each. Each trolley has a 125-ton main hoist, and a 25-ton auxiliary hoist. The crane has a span of 65 ft 2 in. between centerlines of the crane runway rails. The crane runway is about 380 ft. long.

The generator rotors, which weigh about 450 tons each, will be handled by the two cranes working together by means of a special lifting beam attached to the main crane hooks. The bridge, trolley, and hoists are all driven by 440-v, 3-phase, 60 cycle motors which are operated from a structural-steel-frame operator's cage attached to each crane.

Main Turbines

The main turbines are of the vertical-shaft, single-runner, Francis type with spiral casings and have a rating, at full gate and at a head of 330 ft, of 103,000 hp each, which corresponds to the generator rating of 75,000 kw at unity power factor. The net effective head under which the turbines will operate may vary from 238 to 475 ft. The 238-ft head will be of short duration and will occur at infrequent in-

tervals. The net effective head will vary between 366 and 475 ft for 75 per cent of the time. The average net effective head will be about 408 ft. The turbines will operate at a normal speed of 138.5 rpm.

The turbine runners are of one-piece cast steel, and are provided with bolted flange connections for attachment to the turbine shafts. The shafts are made of forged open-hearth steel, heat treated, and have a 7½-in. diam hole bored axially throughout their length, to permit visual inspection of the interior metal. The turbine guide bearings are of the oil-lubricated, babbitt-lined type, and are located above the runner.

The turbine wicket gates are operated by two servomotors, which are operated by oil under a pressure of 250 to 300 psi, and are capable of making a complete opening or closing stroke in 4 sec, with an oil pressure of 250 psi in the tanks, and an effective head of 475 ft on the turbines. Provision is made for retarding the rate of turbine gate closure, from a position corresponding to that of about speed-no-load at maximum head to a fully-closed position, in order to limit pressure rise in the penstocks.

Main Governors

The main governors are of the oil-pressure, relay-valve, actuator type with speed-responsive elements driven by electric motors. Energy for driving these motors is obtained from permanent-magnet, alternating-current generators mounted on top of, and direct-connected to, the shafts of the pilot exciters on the main 75,000-kva generators. The normal operating oil pressure will vary from 250 to 300 psi. Each governor is provided with two electric-motor-driven oil pumps interconnected in such a way that they can be operated independently or together. When operating together, either pumping unit may be used for normal operation, with the other unit available for standby service. Both pumping units are arranged to start and stop automatically.

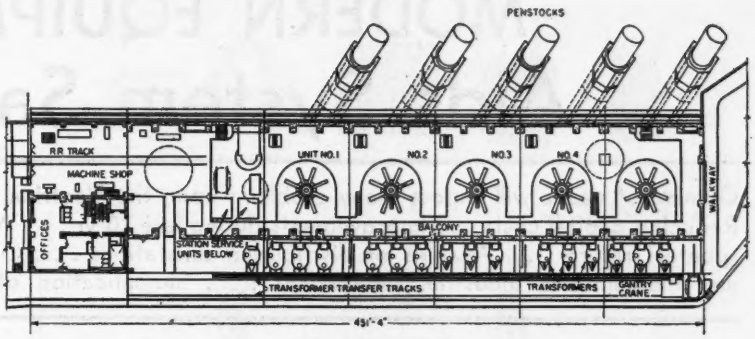


Fig. 5. Plan of Shasta power house, showing ultimate installation of five 75,000-kw generating units, two of which are now installed

Main Generators and Exciters

The main generators are of the vertical shaft, water-wheel-driven type with direct-connected main and pilot exciters. Each generator is rated 75,000 kva, unity power factor, 60 cycles, 3 phase, 13,800 v, 138.5 rpm.

The generators are designed so that when delivering rated output continuously, the maximum operating temperature of the armature and field windings will not exceed 100 C (212 F) with the entering air at 40 C (104 F). The stator core of each generator is built up of high-grade, non-aging, thin-laminated, silicon steel, with each lamination coated on both sides with insulating varnish to prevent eddy-current losses. Guides are installed in the stator core air ducts to provide gradually curving paths for the cooling air as it leaves the air gaps between the rotor and stator and enters the ducts in the stator cores, so as to make the flow of air smooth and quiet and reduce the friction losses.

The stator winding is star-connected and is suitable for either grounded or ungrounded neutral operation. Three main and three neutral leads are brought out of the stator frame and are equipped with bus-type terminals. Differential protection of the stator windings against grounds and short circuits between phases is provided. The stator windings are insulated with class "B" insulation, and are provided with an outer protective taping of semi-conducting material to provide corona shielding. Twelve standard 10-ohm-resistance temperature-detector coils are installed in the stator winding to indicate the highest operating temperature.

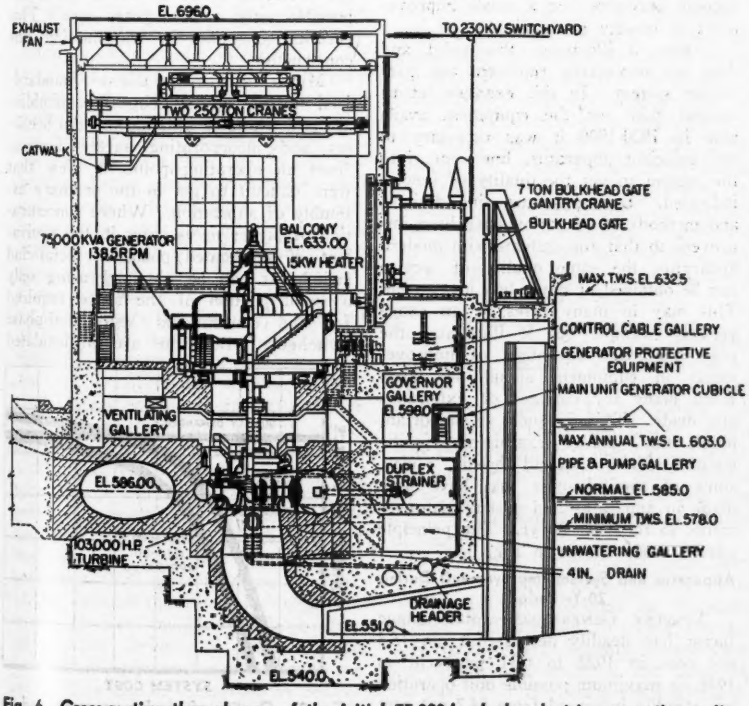


Fig. 6. Cross-section through one of the initial 75,000-kw hydro-electric generating units at Shasta

Generator Cooling

Each generator is provided with a totally enclosed cooling system, including air ducts, surface coolers, and metal air housing. The housing is practically air-tight, which permits the use of automatic carbon dioxide (CO_2) gas fire extinguishing equipment. Cooling air is circulated by means of fans installed on the generator rotors. The surface coolers are spaced symmetrically around the periphery of the stator wrapper plate. Thermostat relays located in the paths of the air leaving the coolers are provided to sound an alarm in case of abnormally high temperature. Thermostat relays located in the air passage ahead of each cooler are provided to control the release of carbon dioxide gas into the generator housing in case of fire.

Generator Construction

The rotor rim of each generator is laminated and constructed of steel plates bolted together. The pole pieces are built up of thin laminations having die-punched dovetails which fit into dovetailed slots in the rotor rim. The pole pieces are held in position by means of tapered keys which are locked in position with steel plates. The field windings are insulated with class "B" insulation and consist of copper strips, wound edgewise. The field poles are provided with discontinuous, low-resistance amortisseur windings.

(*Continued on page* 126)

MODERN EQUIPMENT Aids System Savings*

Coming of peace will impose many problems upon the Electrical Industry . . . Costs vs prices . . . Reducing capital costs . . . Improvements during last 20 yr . . . Where to concentrate effort to get greatest return . . . Analysis of distribution substations . . . Opportunities for economy in small and medium size industrial sub-stations . . . Simplification of layout and reduction of parts

By A. C. MONTEITH

Mgr. Industry Engineering, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

THE STEADY DECREASE in price of electrical energy, shown in Fig. 1, is a delight to us all. It has stimulated much development in all industries. We are doing things electrically today that have made our way of life better, that would have been impossible 20 yr ago.

That costs have not decreased as rapidly as prices, is somewhat distressing. There is trouble—serious trouble—ahead if the trends continue as indicated in Fig. 1. There must be a reasonable margin between cost and price of energy, if the industry is to remain virile. To increase prices will be difficult, if not impossible. Furthermore, I question its desirability, even if it could be accomplished. The conclusion is obvious. Find methods of reducing costs. This is not easy, for reductions in cost must not be made at the expense of service reliability or by cashing some of the system reserves. A reasonable reserve capacity should be maintained for several reasons, the best of which is to withstand the impact of war and other emergencies, of which we have just had such a vivid example.

Methods of Reducing Capital Costs

Any reduction in capital costs will also effect maintenance, taxes and other costs that determine the overall cost of production. This discussion will only cover capital costs. There are various methods of reducing capital costs but the one that is most important and the one to which I will confine my attention in this article is the method of simplifying system layout and the reduction of component parts to a minimum.

The public has been educated to demand a high degree of continuity of service and is so dependent on good service now that lowering the standard of service would be as difficult as increasing prices. We should, however, review the system layout now to take into account the improvements that have been made in apparatus and system designs to improve service reliability. This is important because only up to a certain point do increased costs bring improvement in quality of service. Then we reach the point of diminishing returns and costs become excessive for a small improvement in quality of service.

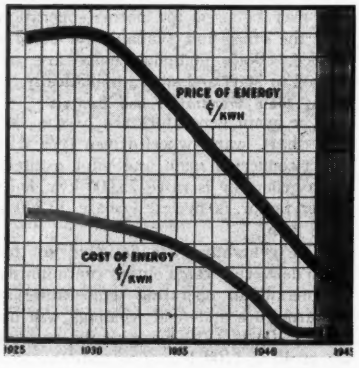


Fig. 1. Steady decrease in price and cost of energy

Figure 2 illustrates this point and does not necessarily represent any particular system. In this example let us assume that for the equipment available in 1920-1930 it was necessary to put sufficient apparatus, lines, etc. into the system to get the quality of service indicated. But apparatus, line designs, and methods of operation have been improved, so that for systems with modern apparatus, the same quality of service can be obtained at much less investment. This may in many cases be an exaggerated example but it illustrates the point that full advantage of improvements in equipment should be taken when plans for changes or extensions are made. This is such an important point, that, before examining specific possibilities, we should briefly review some of the advances that have been made in apparatus and system improvements in the past 20 yr. The principle advances are shown in Fig. 3.

Apparatus and System Improvements During 20-Yr Period

TURBINE GENERATORS—Total outage factor has steadily decreased from 15.3 per cent in 1922 to 6.11 per cent in 1941, or maximum possible unit operation has steadily increased from 84.7 per cent in 1922 to 93.86 per cent in 1941.

CIRCUIT BREAKERS—All modern circuit breakers are now tested at full published kva interrupting capacity in factory laboratories. Twenty years ago designs were based on a few field tests and experience.

Interrupting time has steadily decreased. Twenty years ago the interrupting time of high-voltage breakers was about 25 cycles. Today the interrupting time of 115-kv breakers and above is 5 cycles, which is approximately one-fifth of the original figure and 3 cycle high-voltage breakers are available.

Breakers are now rated on a 15-second duty cycle and have relatively small derating factors for fast reclosing. Breakers 20 yr ago were rated on a two-minute duty cycle.

High-voltage breakers can be built for reclosing in 20 cycles, a speed impossible only a few years ago. This permits economies in transmission line construction.

METAL-CLAD SWITCHGEAR—Standardized metal-clad switchgear assemblies are now available utilizing modern breakers and incorporating safety features from an operating point of view that were difficult to get in the ordinary assembly of substation. Where concentration of power necessitates it, the equivalent of segregated phase in metal-clad switchgear can be obtained using only a small portion of the space required for the conventional segregated-phase switchgear. Bus runs are all insulated

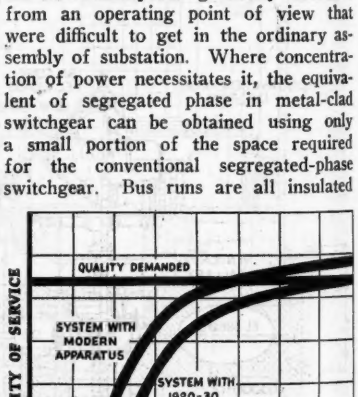


Fig. 2. Quality of service as compared to system cost

*Abstract of an address before the Edison Electric Institute.

for full voltage. These bus runs have a practically perfect service record.

SYSTEM RELAYING—System relaying has been improved so that, in combination with the high-speed breakers, faults can be cleared in a few cycles instead of seconds as was the case 20 yr ago.

TRANSMISSION LINES—High-voltage outage-proof lines are now in operation as a result of the work done over the past 20 yr. Improvements in performance can be credited largely to lowering of tower-footing resistance, more adequate shielding, and coordinated tower designs. High-speed clearing of faults has reduced the burning usually permitting immediate reclosure. Several lines have been in operation for 10 yr with practically perfect operating record. Many lines, 66 kv and above, have had an outage record of less than one per 100 miles per year. The outage factor of one 66-kv line built in 1911 has been reduced from 45 outages per 100 miles per year to three simply by reducing tower-footing resistance. A further reduction to one outage per 100 miles per year would result from adequate shielding.

CABLES—Joints in high-voltage cable have been improved so that there are only approximately one-third the number of cable-joint failures in 1940 as in 1925, whereas in the cable itself, failures are only one-half as likely as in 1925.

LIGHTNING-PROTECTION DEVICES—Lightning protection devices are now thoroughly tested in the factory to assure uniformity. Modern arresters will discharge practically a direct stroke of lightning and still protect the apparatus.

POWER TRANSFORMERS—Many developments have led to greater reliability of transformers. Also, the introduction to tap-changing-under-load equipment has made possible more effective use of lines and equipment than with plain transformers. Some of the improvements in the decade from 1922 to 1932 are improved oil, silverless copper, paper-insulated conductors, brazed coil connections, better gums and varnishes, inert gas to protect the oil from oxygen both in operation and during shipment, and surge proof design. Impulse testing to meet basic insulation levels has been of particular significance. The impulse strength of transformers has doubled in the last 24 yr, while the protection ratio of lightning arresters has decreased by one-half, as illustrated in Fig. 4.

Auxiliary cooling equipment has been used extensively in the last decade to increase transformer capacity.

DISTRIBUTION TRANSFORMERS—As with power transformers, one of the outstanding contributions to more reliable operation of distribution transformers has been the improved impulse characteristics. Full advantage can be taken of this through the use of lightning protective devices capable of discharging most direct strokes of lightning. In 1,900,000 transformer years of service the field failure rate of the protective devices used with transformers of modern design has been 6/1000 of one per cent per year. In the last decade distribution transformer failures of all types including windings, protective devices, etc. dropped from 8/10 of one per cent failures per year to 1/10 of one per cent on a particular group of transformers.

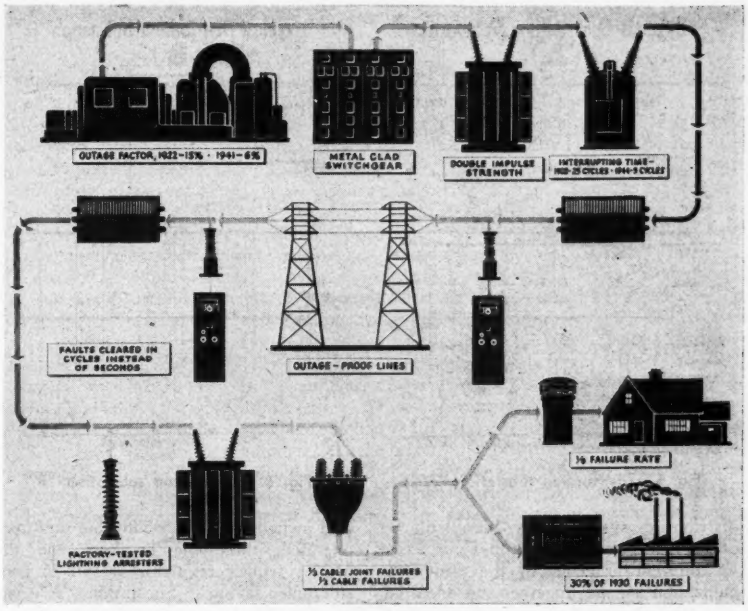


Fig. 3. Two decades of progress

GENERAL—These examples are incomplete but suffice to show that in the last 20 yr the reliability of equipment has materially improved so that it should be possible to modify our thinking in connection with the equipment that is put into systems and still maintain a high degree of reliability. Also, the pyramiding of probalities should be eliminated where possible to minimize the amount of equipment necessary to secure a given reliability of operation. If too much equipment is installed in an attempt to secure an abnormal degree of reliability, it is quite possible, actually, to increase instead of decrease the probability of outage. Considering all factors, we should do everything possible in the planning of a system to use a minimum of equipment.

Where to Concentrate Effort

If we accept the above statements the natural question is, "where can we get the greatest return for a given amount of effort?" In considering this point, let us break the power system into its components: generation, transmission and distribution, being divided 28 per cent for generation, 14 per cent for transmission, and 58 per cent for distribution.

In general, a good job has been done on the generating stations. Attention has been focused on the engineering and building of these because they represent large investments and these investments are made at one time. In the past 20 yr the cost per kw of building a large station has decreased even in the face of providing more elaborate means of retrieving Btu's by the use of superheaters, economizers, and the like. Meanwhile, the amount of coal has been cut from 3 lb per kwhr in 1920 to a low of 1.31 lb in 1942. We can expect some further decrease in fuel cost but it will be slight considering the overall cost of a delivered kwhr. The possible further decreases in station costs are also small.

Transmission systems also have been built up of relatively large incremental investments so that considerable effort has been concentrated on the engineering and building of these lines. The net result is that little reduction can now be made in the transmission system. The capacity of a few systems can be increased by addition of high-speed relaying and by revamping breakers for faster operation. Series capacitors can be used to neutralize the reactance of the system where the conductors are large enough to carry the increased load. The total possibilities for savings in transmission, however, are minor in comparison to what has already been done.

Approximately 58 per cent of the cost of an electric, light, and power system is in distribution. In general,

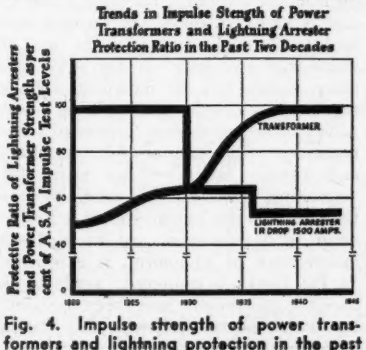


Fig. 4. Impulse strength of power transformers and lightning protection in the past two decades

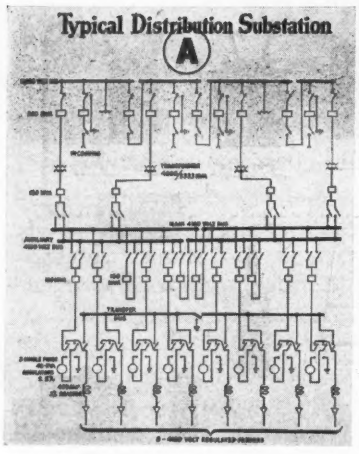


Fig. 5. Distribution substation "A"

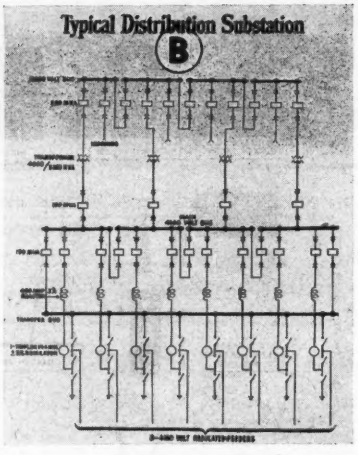


Fig. 6. Distribution substation "B"

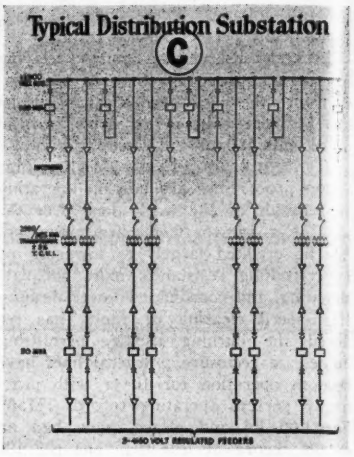


Fig. 7. Distribution substation "C"

distribution systems have been built up of small increments, sometimes purchased by different branches of the utility organization and put together and operated. The tendency has been to emphasize perfection of service.

Some of today's standards of distribution are predicated on apparatus as it performed 20 yr ago. Consideration should be given to the modernization of our thinking on the system as a whole and particularly the distribution system, taking these factors into account. I believe it is possible to minimize the equipment in the distribution system to lower costs when making changes or extensions and still retain the quality of service demanded.

A typical distribution substation, which will be substation "A", is provided with multiple high-tension buses and main and auxiliary breakers on the secondary bus and a transfer bus for cutting regulators in and out of service as shown in Fig. 5. Also, single-pole operated breakers have frequently been used so that one line is opened on a single-phase fault. In other words, with a 2000-kva feeder only 666 kva would be lost for a single-phase fault. For the purpose of discussion, the equipment cost of this station will be taken as 100 per cent or $22 per kva of firm demand at the substation (which will be the basis of comparison of all kva costs). This station does all that a distribution substation should do but its cost is high. Some of the features that lead to its high cost are: the use of single-pole switching on the 4-kv primary feeders and the individual voltage regulation on any phase. Most companies have found these refinements unnecessary. The use of 4-kv auxiliary and transfer buses and the many disconnecting switches, to minimize the time of a service outage should a failure occur in a substation, and to facilitate maintenance of equipment, is expensive. In the light of equipment available in the 20's this might have been justified, but with modern equipment this station is more elaborate than necessary.

The introduction of standard metal-clad switchgear with removable multiple-operated, three-pole breakers and the use of triplex regulators result in considerable saving. Substation "A" has been modified to permit the use of this modern equipment which becomes substation "B" shown in Fig. 6. This substation and the one of Fig. 5 are identical in performance except for three-phase feeder operation instead of single-phase operation. This results in a substation cost of 63 per cent or $14 per kva.

In addition to the use of modern standardized equipment, further cost reductions may be made by changing the fundamental substation diagram. Substation "C", Fig. 7, illustrates this point and can be used in building new substations or rebuilding old ones. Except that no 15-kv substation transformer breakers are used, the 15-kv switchgear layout is basically the same as that of substation "A". It has been modified only in detail to utilize standard metal-clad switchgear. Beyond this point, however, this substation is unlike substation "A". It is designed on a 4-kv unit feeder basis. There is no 4-kv bus in this substation. With this type of distribution, employing relatively large circuits, facilities must be provided outside the substation on the 4-kv feeders for switching the load of any feeder to two or more adjacent feeders so as to restore service quickly following a feeder failure. Because these facilities must be available elsewhere in the system, even a 4-kv transfer bus has been omitted from substation "C". External switches are utilized when it is necessary to take a substation transformer out of service. Any circuit breaker can be withdrawn from its compartment and the spare breaker inserted. The outstanding advantages of substation "C" are simplicity, unit design with accompanying flexibility for load change, decrease in possible 4-kv short-circuit current and the accompanying system voltage disturbance, lower losses, and its lower cost. The equipment for this substation will cost approximately 54 per cent of that of substation "A" or $12 per kva.

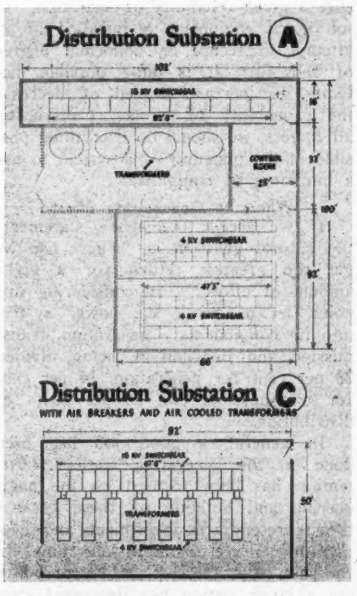


Fig. 8. Floor plans of distribution substation "A" as compared with that of substation "C"

The location of all the substation equipment indoors naturally raises the question as to the size of the building required to house it. From Fig. 8, showing the floor plan of a building to house substation "A" and substation "C", the difference in apparatus costs and cost of installation is apparent.

The transformers and voltage-regulating equipment of substation "C" cannot be as conveniently de-energized for maintenance as in the case of substation "A" without the dropping of load. This is because, as pointed out, load must be switched outside of the substation from one feeder to others. Where external feeder switching equipment is not available, this substation can be modified to substation "D", as shown in Fig. 9, to include a transfer bus, thereby permitting all switching for maintenance of station equipment to be done in the station. Thus, to obtain the greater convenience for maintenance

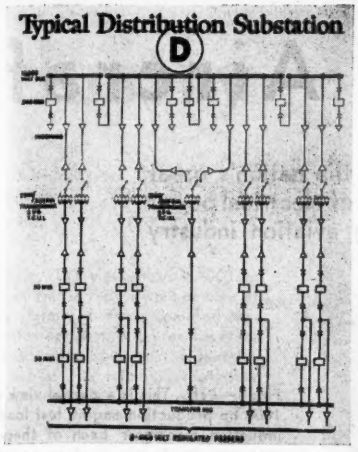


Fig. 9. Distribution substation "D"

provided in substation "D" as compared to substation "C", the station equipment cost has been increased approximately $2 per kva, with a slight increase in building and installation costs.

This discussion so far has been directed to indoor substations. However, these substations can be constructed with outdoor equipment. In the case of substations "C" and "D", the equipment arrangement and cost will be approximately the same whether installed indoors or outdoors. Outdoor oil-insulated transformers have been substituted for the indoor air-cooled transformers. The substation space will be increased about 25 per cent because of the increased size of the outdoor transformers.

Where new designs and the greater reliability of equipment and lines are taken into account, combining installation and equipment costs result in a substation costing less than 50 per cent of that of the more elaborate substations designed and built on the basis of former service records and experience with the older types of equipment.

Why, then, can substations "C" or "D" be considered when substation "A" was once deemed necessary? Reviewing the data given on reliability of apparatus and lines, the 4-kv cables have only about one-third the probability of failure now that prevailed in the 20's and transformers have been improved even more. This alone justifies a change from single phase to three-phase operation as the outages per customer caused by cables and transformers should be about the same or even less. The complicated bus arrangement of yesteryear was provided so that feeders could be switched in case of failure of equipment in the substation itself. The probability of failure of equipment in the substation has been minimized because of the complete factory testing. Metal-clad switchgear with complete enclosure of all live parts, air-insulated transformers with tap changing under load and air circuit breakers throughout allow placing all the equipment together in one building. The necessity of single-phase regulation in all cases is questionable.

These same arguments hold for open lines as for cables. Overhead lines are now being built with self-clearing characteristics, but if faults still persist, the vast majority are cleared by de-energizing the feeder and service is automatically restored in a few seconds.

Industrial Power Supply

Another opportunity for economy is in the equipment for distribution systems serving small and medium-size industrial customers. Many of these are supplied from high-voltage loops as shown in Fig. 10. One practice is to supply each of a number of industrial substations with equipment as shown in substation "J", which will be the basis of comparison for all schemes. This and all other substations in Fig. 10 are designed to serve an industrial customer having a load demand of 1000 kva. Substation "J", costing $22 per kva, provides excellent service to the customer. A loop fault on either side of the substation does not cause any interruption to service. A failure of the transformer will, of course, interrupt the power supply until a good transformer is connected in its place. Transformers are so reliable, however, that additional expense cannot normally be justified to prevent a service interruption that will probably not occur once during the life of the substation. Substation "J" probably gives better service continuity than can be economically justified for many customers.

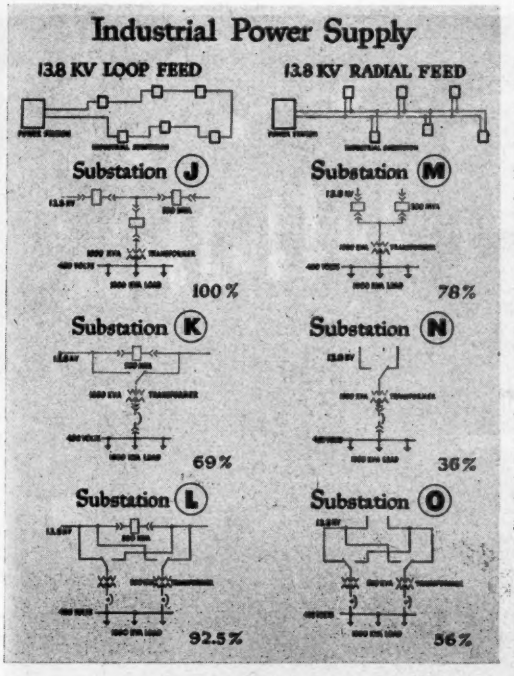


Fig. 10. Feed arrangements and substations for industrial power supplies

The probabilities are that a fault will occur about once every five yr on one of these industrial loops. If so, substation "K" costing about $15 per kva or 69 per cent of substation "J", can be used to provide adequate service to the great majority of industrial customers. If a fault occurs on the 13.8-kv loop to the right of substation "K", the customer's power supply is interrupted but his service can be quickly restored by opening the circuit breaker in the secondary leads of the transformer, closing the transformer primary switch on the left to connect the transformer to the good section of the 13.8-kv loop, and reclosing the air circuit breaker. Except in this one case of trouble, which probably will cause interruption only once in 15 to 20 yr, substation "K" provides substantially the same quality of service as does substation "J" and has an overall saving of about 30 per cent.

The few customers requiring best possible service continuity can be supplied most economically through substation "L". This substation gives somewhat better service than substation "J" at an equipment cost of approximately 92.5 per cent or about $20 per kva. By using substation "K" for 90 per cent of the industrial customers and substation "L" for 10 per cent of them, instead of using substation "J" throughout, an aggregate saving in industrial substation cost of 29 per cent can be made.

A further saving in investment can be made by using two radial feeders to supply a group of industrial customers, as shown on the right of Fig. 10. Using this radial supply scheme, the length of cable required will be anywhere from equal to about 50 per cent more than that required when using the loop supply, depending upon the geographical location of the customer served. The possible reduction in size of cable and the fact that both radial feeders can be carried in one duct bank, however, will make the cable supply costs for either loop or radial feeder about equal. Therefore, the savings in substation costs when using the radial supply represents a net saving. Substations "M", "N", and "O" are comparative to those discussed for the loop feeders. When using the radial feeder and substation "N" for 90 per cent of the customers and substation "O" for 10 per cent of the customers, a saving of 62 per cent in substation equipment cost is made when compared with using the 13.8-kv loop feeder and substation "J". Even if substations "K" and "L" are used, as recommended with the loop feeder, the saving in substation equipment cost is 47 per cent if the radial feeder and substations "N" and "O" are used. The radial feeder and substation "N" make it economical to supply in this manner many small industrials now supplied through the large distribution substations along with the residential and small commercial customers. This will release distribution-substation capacity.

POWER In The Aircraft

These Westinghouse pictures, taken in one of the nation's great aircraft engine plants emphasize the importance of electrical power and control devices in the rapidly expanding aviation industry

Fig. 1—Left. This is a partial view of the 1000 hp production engine test load-back induction machines. Each of these generators is located back of an engine test cell. During the test, the airplane engine is coupled to the shaft of the generator, and the power so produced is delivered to the main power system

Fig. 2—Below. A view of the 100 kw bell type nitriding furnaces with the hood raised on one unit to show the heater element construction and the inner hood

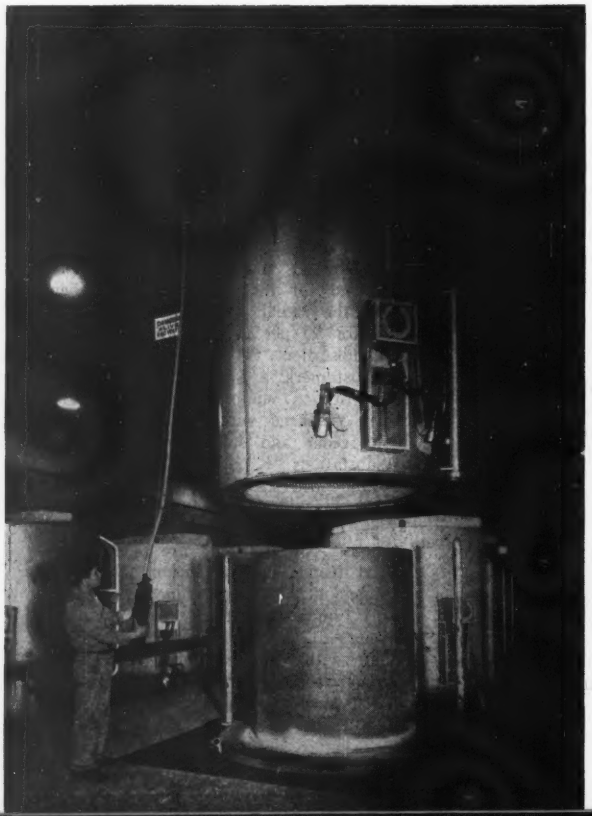
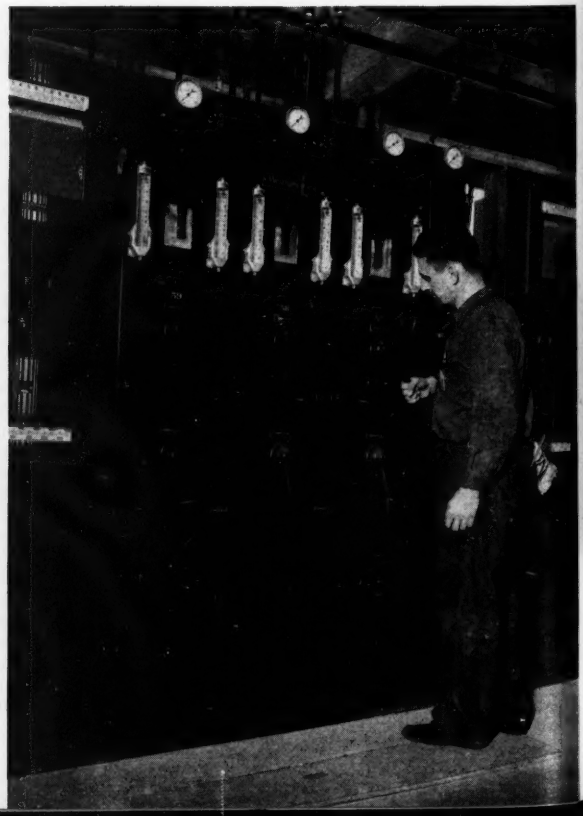


Fig. 3—Below. This is a front view of the operating panel for three of the bell type nitriding furnaces shown in Fig. 2. The recording instrument panels for the furnaces are mounted on adjacent panels



t Industry

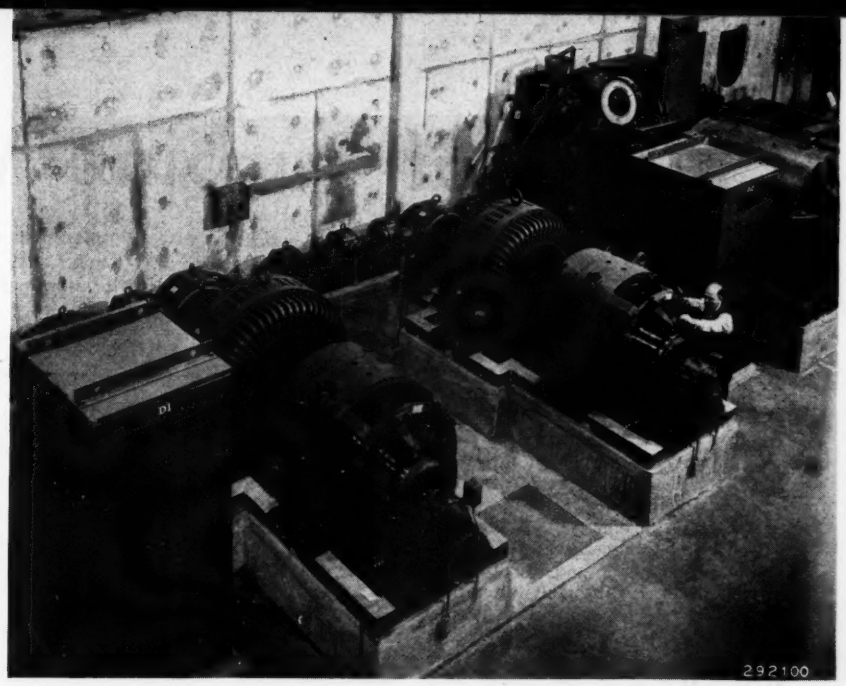


Fig. 4—Right. This view shows a 4000 hp combination cradle type dynamometer at the upper right with the associated motor generator set in the center together with the exciting equipment. Incidentally, the MG set at the left is for another 4000 hp dynamometer not shown in this picture

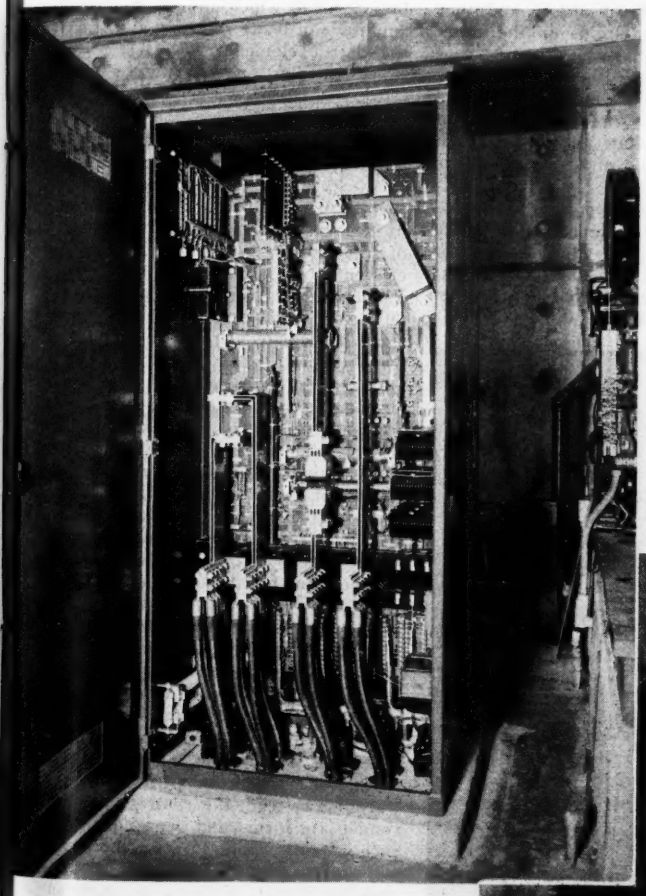


Fig. 5—Left. A rear view of a direct current control cubical for a 400 hp direct current unit which is a part of the 400 hp combination cradle type dynamometer shown in Fig. 4. All control wiring and equipment is completely enclosed

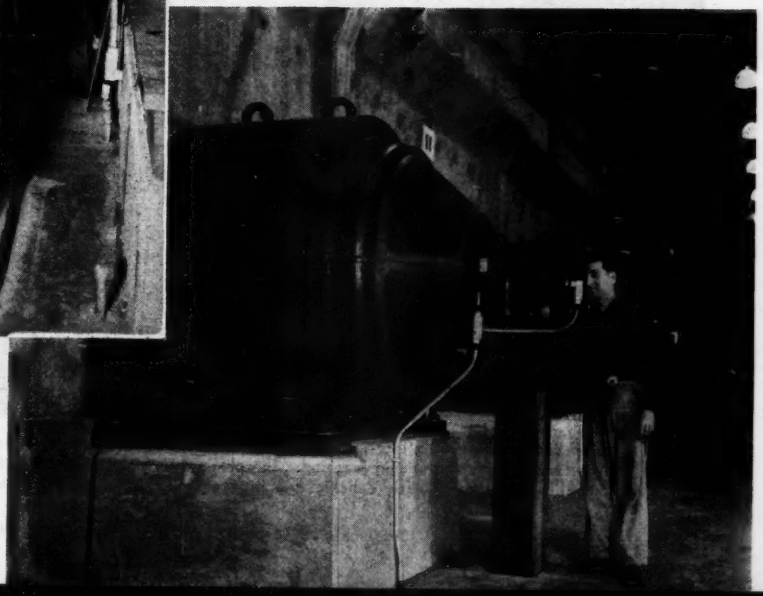


Fig. 6—Right. A close-up of one of the 1000 hp load-back induction machines used for engine production testing

Causes of Turbine Vibration

Vibration indicates a faulty condition and must be kept from reaching dangerous proportions . . . Causes may be within turbine, in generator or outside the unit . . . Shaft vibration meter helpful to operator is described

By Ralph E. Turner, Editor, Power Plant Engineering

LIKE THE TEMPERATURE of a sick human patient, the vibration of an operating steam turbine is an indication of the existence of one or more of many defects in the condition of the turbine. It is difficult, indeed, to determine what the principal causes might be and usually more difficult to correct the faults after they have been found, for the turbine, though a giant producer of power, is as sentive in operation to imperfections as an athlete is to raw nerves in a blistered heel.

The turbine is, however, one of the most reliable pieces of equipment in the power plant, in many instances running months on end without the necessity for a shutdown. This reliability is due, at least in some measure, to the sensitivity of the unit which gives warning to the operator in advance of real danger. Vibration is one of these indicators of the operating conditions and the more the attendant knows about causes of vibration the better qualified he will be to judge the safe condition of his unit. Aids in this direction have been developed by turbine manufacturers in the form of instruments designed to indicate the magnitude of shaft vibration and some idea of its cause, but it is intended here to give first a number of reasons why vibration occurs. Those cited here are among the most common and should be given consideration in all cases where the vibration is excessive.

Unbalanced Rotating Forces

Turbine vibration that is most noticeable to the operator is caused by unbalanced rotary forces. This occurs when the centrifugal forces set up by elements in rotation are not in dynamic balance and cause the rotor to vibrate within its bearings and thus place alternating strains on the entire supporting structure. Although very few turbines are without some vibration this condition must be watched carefully to be sure that it is not excessive and that its cause is not a gradual weaking of an elment in the structure.

Vibration, however, is not confined to the rotor as a whole, for there are forces that act on the elements of the turbine, such as the blades, that cause these elements to vibrate sometimes with destructive effects. This condition may have little or nothing to do with the vibration within the bearings. When, however, a blade becomes cracked, loose or broken in such a way as to upset the rotary balance, its effect may become noticeable in the operation of the turbine.

In recent years laboratory studies have been made to determine the extent of these blade vibrations, and how they can be prevented from becoming destructive to these elements. As a result of these studies turbine designers have made changes in blade designs, lashing and supporting arrangements, and steam nozzle distribution, all of which add up to reduced amplitude of blade vibration and longer life of the elements.

Loss of Blades

Blades may be lost for other reasons than the vibration of the element due to the impact of the steam. Failures may result from faulty construction, injury to parts during erection or repair, erosion due to jet action of the steam, corrosion of holding elements, or a number of other causes. Whatever the cause of blade failure one of the most reliable symptoms is an immediate increase in amplitude of vibration.

Rubbing between the rotor and stationary parts is one of the most frequent causes of vibration, for it results from such common causes as worn main or thrust bearings, or by raising of the blade packings. These symptoms may come gradually as the rubbing increases so the need for comparing vibration amplitude with previous performance becomes evident.

Use of Turning Gear

Not all rubbing is due to bearing wear, however, many times operators experience rubbing and vibration during starting periods only. This is usually due to the warping of the spindle or shaft from uneven heating during the shutdown period. When warming up with the rotor stationary, condensate forms and causes a difference in temperature between the upper and lower parts of the spindle thus warping it out of shape to such an extent that when brought up to speed in that condition vibration takes place and, in severe cases, rubbing. So commonly does this occur that, particularly with large units, provision is made to keep the rotor turning over

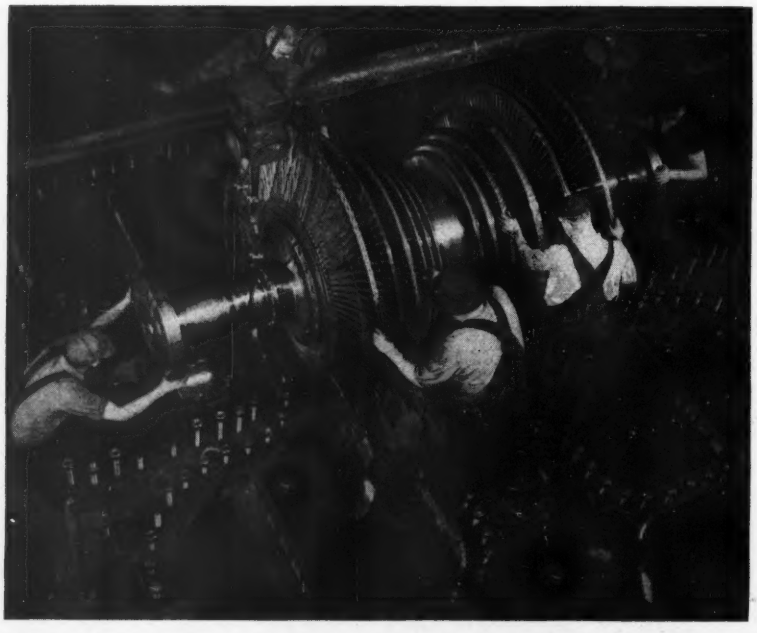


Fig. 1. Extreme care must be used in every phase of design, manufacture and erection of a turbine unit to obtain a smooth running machine. The placing of the rotor in the cylinder, illustrated above, is a particularly delicate operation whether in the shop or field

slowly by power from another unit, so that the spindle will be kept evenly heated during standby periods when steam is keeping it hot. Units not provided with separate turning equipment requires longer starting periods to insure even heating before they are brought up to speed under full steam pressure and temperature.

This temporary warping must not be confused with a permanent bend in the shaft. While the immediate symptoms may be similar in that there is rubbing and vibration, that due to temporary temperature warping gradually disappears as the unit continues in operation while the unit with a bent shaft keeps up its vibration as long as it is in operation. There is also the possibility that temporary warping may cancel out, for a short time, the vibrating effect of a bent shaft, depending upon the position of the rotor during the heating up period, or, for the same reason, it may cause more severe vibration during the starting period.

Cracks in Spindles or Wheels

Vibration may also result from cracks in the spindle or in the wheels. During the initial period of operation, a turbine unit is watched with extreme care to discover all defects of materials and construction and at the time of the first inspection every precaution is usually taken to make certain that no defects escape notice. Nevertheless, the strains that occur within the metal parts of a turbine rotor are enormous and varied, too frequently causing crystallization and cracks that develop progressively into dangerous conditions noticeable only to the most keen observers of turbine operation. Here again, the symptom of this growing weakness is a progressive amplitude of vibration.

As units become older, the strain of operating conditions and the destructive effects of corrosion and erosion become evident in such conditions as loose spindle fits. At times of inspection when the unit is dismantled these conditions should be carefully checked but, with the unit in operation, vibration is the symptom to watch.

Generators May Cause Vibration

The causes of vibration are not confined to defects in the turbine end of the unit, for conditions in the generator end also have a way of developing that is not conducive to smooth running. During operation, field coils occasionally become loose due to expansion and contraction with changes in temperature and consequent adjustment of their insulation casing which, in some cases, is sufficient to unbalance the centrifugal forces developed during operation and thus cause vibration of the unit.

Cases have also been known where insulation has broken down between wires in a field coil thus short circuiting part of the coil and unbalancing the magnetic pull on the two sides of the field. Vibration, of course, results when such a condition exists.

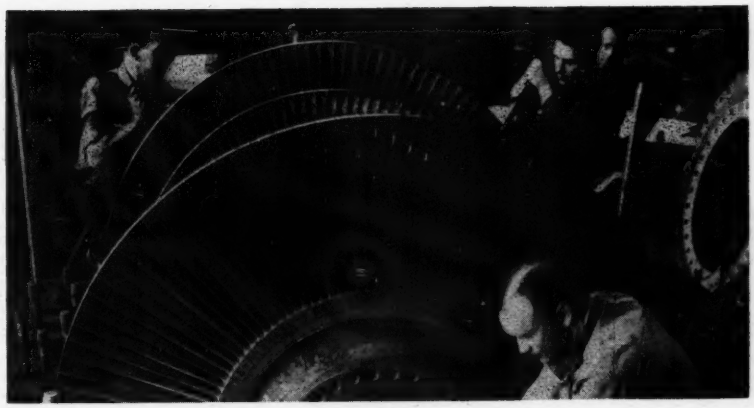


Fig. 2. When blades like these, 38 in. long traveling at a speed of 13 miles per min, give way almost anything can happen. Small blades may let go with little more indication than an increase in vibration

An uneven accumulation of dirt in hollow spindles or in generator fields has contributed to the vibration problems of the steam turbine unit. There are, of course, many ways in which this dirt is caused to distribute unevenly around the interior surface of the spindle but one of the most likely is when the turbine is shut down the dirt is no longer supported by centrifugal force and drops to the bottom side of the spindle. In starting up it may roll around for a moment but it is not likely to become evenly distributed and the unbalanced weight, small though it may be, is sufficient when the turbine is up to speed to have a vibrating influence on the unit.

In some instances engineers have traced vibration causes to worn or misalined couplings between the turbine and the driven elements, and to the binding of gears driving governors or oil pump. So enormous are the centrifugal forces at the tremendously high speeds of steam turbines that small variations in weight or movement of particles become great in their effects on the dynamic balance of a turbine rotor.

Smooth running requires that the turbine cylinder be so supported that the rotor will run in a perfectly horizontal position so that the shaft will not be pulled endwise but will be free to oscillate slightly with variations in end thrust. This freedom is so necessary that a thrust bearing that does not slide freely may set up vibration in the turbine.

Above all conditions essential to good turbine operation is a solid, substantial foundation which supports the unit. This must maintain the turbine in perfect alinement. Turbine vibration if unduly severe, is likely to cause the foundation to deteriorate, the concrete to give way under the turbine bed. A cumulative effect thus results when alinement of the unit is imperfect.

Many cases of turbine vibration are the result of faulty operating methods or neglect on the part of the man in charge of operation. Neglect of the water-sealing glands has been known to cause vibration when water spills through and comes in contact with the dummy or spindle causing temporary warping of the spindle.

Lack of proper provision for pipe expansion and contraction puts strains on turbine supports that affect alinement and bring on vibration. Similar conditions result from improper condenser piping as well.

Faulty lubrication which causes the journal to climb up the side of the bearing, whether due to the use of the wrong kind of oil, an ill-proportioned bearing, or improper oil grooving, is a common cause of vibration that is not difficult to correct.

Driven machines such as reduction gearing, fans and pumps connected directly to the turbine if worn, not carefully balanced or handling loads that shock the unit have given trouble to the delicate turbine element.

The condition of the steam as it comes to the turbine is an extremely important factor in the successful operation of the unit. Good operation cannot be expected unless the unit is supplied with steam at the pressure and temperature for which the unit was designed, and dangers are imminent when slugs of water, from whatever cause, are drawn into the turbine for they not only put an extreme physical strain on the turbine blades and cause erosion, but the sudden cooling effect causes temperature strains and distortion of the cylinder which may result in vibration. One of the troubles yet to be completely solved is the accumulation of deposits on turbine blades. These in themselves are detrimental to the efficient operation of a turbine but in addition, their presence is a continuous threat of danger from the vibration caused when chunks let loose and the damage they do to blading. In extraction turbines, water is sometimes returned to the turbine

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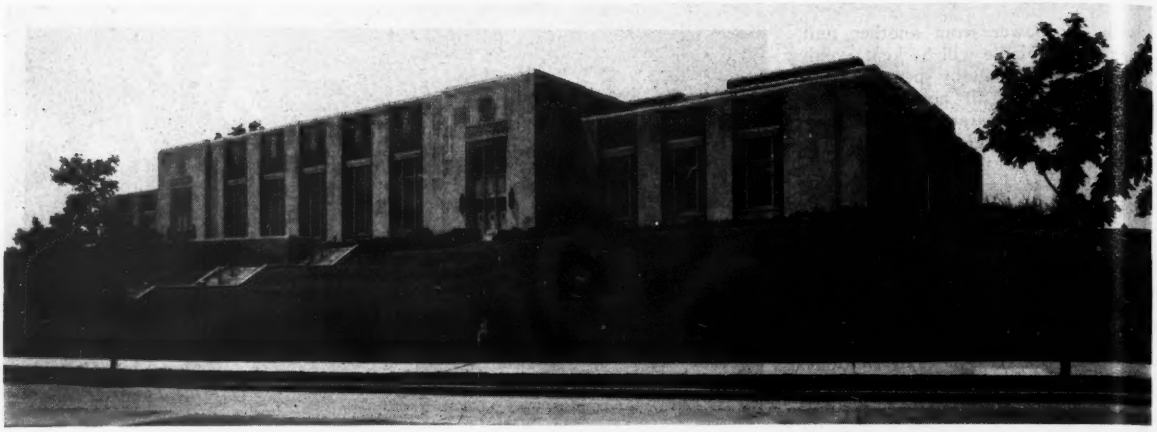


Fig. 1. Philadelphia Central High School

Fuel Economy In Heating Philadelphia Schools

Analysis of Year's Operation Gives Further Proof of Efficiency of Smaller Sizes of Anthracite When Burned in Modern Equipment. Data Given on Combustion Equipment

By ALLEN J. JOHNSON, Combustion Engineer, Anthracite Industries, Inc.

TOTAL FUEL expenditure of only $627,000 was required to provide heat for more than 215,000 Philadelphia public school pupils who attended regular classes during 1942-43. Of the 243 school buildings, 241 are heated by anthracite—and 236 of the latter burn some one of the four sizes of buckwheat. Indicative of the magnitude and complexity of the heating problems involved is the fact that over half the schools (124) have a content of 500,000 cu ft or more each, while three out of every four annually consume in excess of 100 tons of anthracite each.

Because of modern combustion equipment, the fuel economy of the Philadelphia school system probably is greater than that of any other group of buildings of comparable size under one management. Including national defense activities, which kept some of the schools open around the clock and others until late in the evening, the 81,466 tons of anthracite burned during the school year of 1942-43 heated a total of 181,397,000 cu ft of space for an average of 2,225 cu ft per ton. Those results are all the more remarkable in view of the fact that each school is ventilated continuously, even in the coldest weather, with 30 cu ft of outside air per pupil per minute. If similar economy could be obtained in domestic practice, the average home could be heated with less than five tons of coal per year.

The proper size of coal for each school was chosen on the basis of comparative cost and the combustion equipment and labor available. Several years ago, when many of the buildings were erected, No. 1 buckwheat was the preferred fuel. It is but natural, therefore, that 191 buildings—nearly four of every five—still burn that size. In recent years, as a result of advances in the art of burning the smaller sizes of anthracite, many of the larger schools have been equipped to handle No. 3 (barley) and even No. 4 buckwheat. Today, of the 19 schools having a content of 2,000,000 cu ft or more each, 9 are using No. 3 and two No. 4 buckwheat. Of the others, 4 are burning No. 2 (rice), two No. 1 buckwheat, and two are using No. 6 fuel oil.

The accompanying table shows the number of schools burning each type and size of fuel, their total cubic content, the unit cost of heating, per cent savings effected through the use of different sizes of anthracite, and other pertinent data. Because of similar radiation and other losses, and also because they have like plant capacity, only the schools using No. 6 fuel oil and No. 3 and No. 4 buckwheat are truly comparable. And it is in those schools that the savings of the smaller sizes of anthracite over fuel oil are most marked. Thus, although the average saving in fuel cost of anthracite over oil amounted to 19.2 per cent, it was 22.3 per cent for No. 3, and 44.1 per cent for No. 4 buckwheat. Similarly, while the average saving with the smaller sizes of anthracite compared to No. 1 buckwheat was 14.2 per cent, it was two

Fig. 2. Bok-Southwark Vocational School in Philadelphia

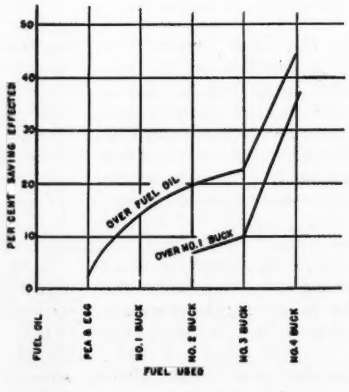


Fig. 3. Savings effected in heating costs of Philadelphia public schools by the use of anthracite of different sizes. (School year 1942-43)

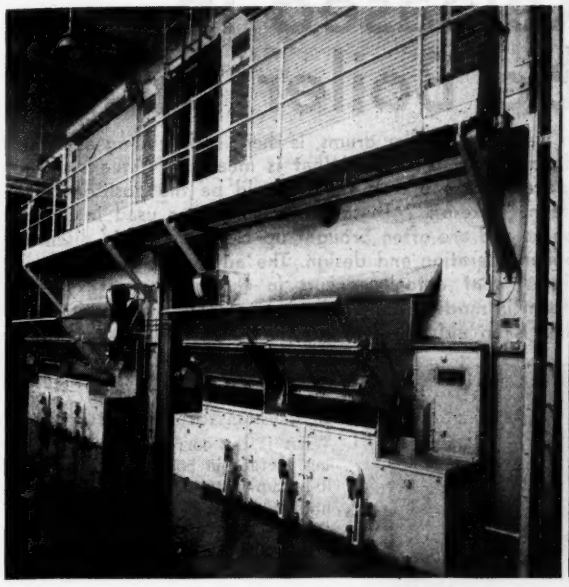


Fig. 4. Boiler room of Central High School showing "semi" stokers installed

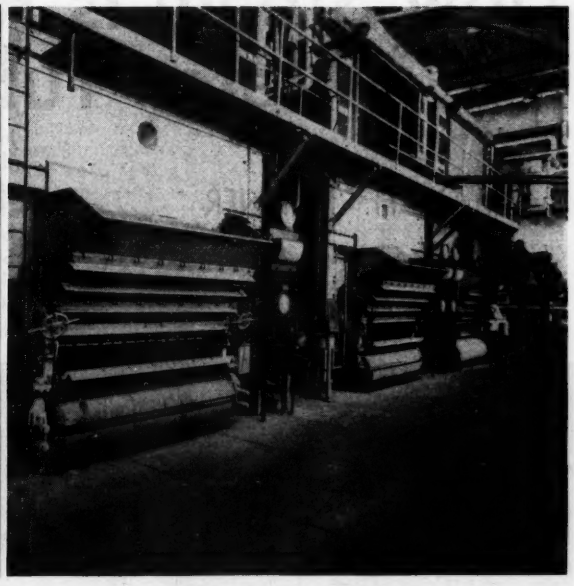


Fig. 5. Traveling grate stokers installed in Bok-Southwark Vocational School

and a half times as great (35 per cent) at those schools using No. 4 buckwheat.

Two types of combustion equipment principally are installed in those schools burning No. 3 buckwheat — McClave, Type MA "semi" stokers, and traveling grate stokers. In every case, careful attention has been given to the problems of coal handling and ash removal.

A typical example of modern heating practice is afforded in the new 2,300,000 cu ft Central High School where No. 3 buckwheat is burned on two "semi" or hand stokers. After weighing on floor scales, charges of coal are delivered to the stoker hoppers by motorized lift lorries. From the hoppers, it is pushed by a hand mechanism onto inclined dumping grates. Ash is discharged into sloping-bottom hoppers under the boilers, from which it is emptied by gravity into wheelbarrows and transferred to an endless conveyor which elevates it to the street level for removal.

Ultra-modern in design and construction, the 4,759,000 cu ft Bok-Southwark Vocational School also uses No. 3 buckwheat but burns it on three Coxe traveling grate stokers. Manual handling of coal and ash is reduced to a minimum by motorized lift lorries and steam-jet ash conveyors.

The heating plant of the largest building in the system, West Philadelphia High School which contains 4,875,000 cu ft, likewise is equipped with three Coxe traveling grate stokers. However, special grate keys originally were installed to permit the use of No. 4 buckwheat. Motorized lift lorries and an unusually complete steam-jet ash removal system are employed. A feature of the latter is the inclusion of outlets for collecting and removing fly ash from the stack and boots within the boilers.

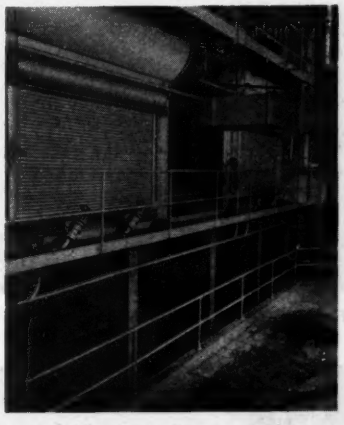


Fig. 6. Alley for ash removal in Central High School

Visitors to any of the newer Philadelphia school buildings are impressed by the exceptional cleanliness and neatness of the heating plants. There is no evidence of coal or ash, outside their proper places, and boilers and appliances are unusually well painted and maintained.

Many heating and power plants may find it profitable to study the results obtained with barley anthracite in the schools of Philadelphia. Not only is No. 3 buckwheat one of the most economical of fuels, but also it is perhaps the only one of which there now is a surplus. That is because war demands for the larger sizes of anthracite necessitate the preparation of quantities of barley in excess of current requirements. For that reason, and also because modern equipment makes it a convenient and fully automatic fuel, No. 3 buckwheat offers the assurance of adequate heat and power without fear of shortage or rationing.

Kind and quantity of fuel consumed by Philadelphia public school system. (School year 1942-43)

	TOTALS AND AVERAGES	B U C K W H E A T				PEA & BUG	FUEL OIL (#6)
		#4	#3	#2	#1		
NUMBER OF SCHOOLS USING EACH TYPE FUEL	241	2	10	33	191	5	2
TOTAL TONS COAL CONSUMED	81,466	5,012	19,213	14,500	42,537	204	727,006 GAL.
TONS CHARGED TO NATIONAL DEFENSE ACTIVITIES	10,711	1,938	5,488	2,600	685	-	280,943 GAL.
TONS BALANCE	70,755	3,074	13,725	11,900	41,852	204	446,063 GAL.
TOTAL CONTENT OF BUILDINGS (MILLION CU.FT.)	181,397	8.67	31.6	30.2	110.3	0.63	6.81
AVERAGE CONTENT/SCHOOL (MILLION CU.FT.)	0.75	4.34	3.16	0.92	0.58	0.13	3.41
TONS COAL/MILLION CU.FT. (EXCLUDING NATIONAL DEFENSE)	390	354	434	394	380	325	65,472 GAL.
CU.FT./TON COAL	2,565	2,820	2,300	2,540	2,635	3,070	15.3/GAL.
COAL COST/TON (1943)	$7.23	$5.50	$6.25	$7.10	$7.90	$10.47	$0.0533/GAL.
COST/MILLION CU.FT. OF CONTENT	$2,820	$1,950	$2,710	$2,800	$3,000	$3,410	$3,490
% SAVING OVER FUEL OIL	---	44.1	22.3	19.8	14.0	2.3	—
% SAVING OVER #1 BUCKWHEAT	---	35	9.7	6.7	—	—	—

How Steam Is Released In Water-Tube Boiler Drums

By MAX H. KUHNER

Chief Mechanical Engineer, Riley Stoker Corporation

In water-tube boiler drums, is there such a thing as "steam disengaging surface"? What is meant by "steam storage space" in the drum? What should be the position of the steam "take-off"? These terms have been used in old text books and are often brought up by engineers in discussing boiler operation and design. The author clarifies them and shows what actually occurs in the process of releasing steam in modern boilers. Engineers need a clear picture of this as an aid in operating the modern water-tube boiler

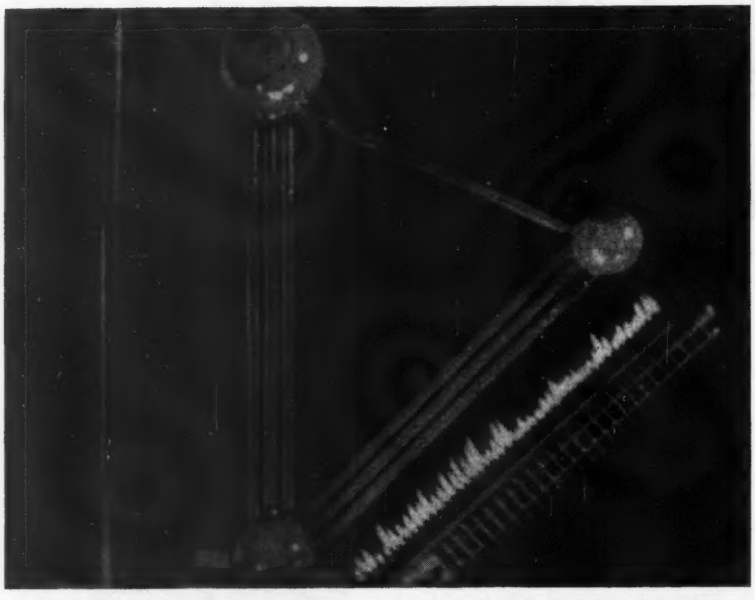


Fig. 1. Glass tube model of 3-drum bent tube boiler of older design in operation, showing steam carrying tubes discharging BELOW working water level

Fig. 2. Close-up of steam release drum of boiler shown in Fig. 1
Note: turbulence in drum; steam space filled with steam-water mixture; no well-defined water level; steam "disengaging" and carrying water along into steam space; steam discharging through nozzle very wet.

WHEN BOILER DESIGNS are being discussed, the following three questions are frequently asked:

1. What is the correct steam disengaging surface in boiler drums per 1000 lb steam output rate, or per boiler horse power for various working pressures?
2. What steam storage space should the boiler have?
3. How high should the steam take-off be above the working water level?

To answer these questions, it is first necessary to define the terms used. They became popular because they are mentioned in many of the older engineering text books, but if an attempt is made to apply them to modern boiler practice it is found that these terms are not descriptive of what takes place inside the boiler drum.

Steam Disengaging Surface

Steam disengaging surface of the older type boiler was taken to mean the area of the water level in the top drums. It was assumed that the steam generated rises uniformly from the water surface.

While it was not possible to see the water level with the boiler in operation, the action of the water in the gage and the steam quality delivered were clues to what was going on in the drums.

"Commercially dry steam" was usually guaranteed by manufacturers for the old types of boilers. It was meant that the steam delivered by the boiler would contain 2 per cent moisture if boiler water conditions were favorable. Water level fluctuations of 3 in. to 6 in., as indicated by the water gage, were not unusual even with relatively light load changes. Wet steam and unstable water level pointed to the fact that considerable turbulence existed in the steam release drum.

Steam is not formed on the surface of the working water level: it is generated in the steaming tubes of the boiler. In most bent tube boilers of the old design, the steam-carrying tubes enter the steam release drum below the water level. The steam must find its way through a body of water before it can enter the steam space of the drum. This fact would indicate that the water contained in the steam release drum is kept in constant turbulence. It is wrong to think of steam "disengaging" from the water level and more correct to assume that the steam enters the drum space with explosive force, forming jets and geysers.

An example illustrates this contention. If a 500-hp 3-drum bent tube boiler built 30 yr ago is operating at 150 lb pressure and 150 per cent of rating, the steam output rate is 24,700 lb per hr. The boiler has a 42 in. diam steam release drum and its furnace width is 10 ft. All steaming tubes enter the drum below the working water level. The steam release per foot furnace width is 2470 lb per hr. Because saturated steam at 150 lb pressure has a volume of 2.75 cu ft per lb, the volume of the steam released is 113 cu ft per min per foot of furnace width. With the water level at the center of the drum, the "steam disengaging surface" is 3.5 sq ft per foot of furnace width. If the steam were disengaged uniformly from 3.5 sq ft, the velocity of disengagement would be 32.5 ft per min. But because the steam must pass through the body of water in the drum, its velocity entering the steam space is certainly many times greater.

It is remarkable that under these conditions it is possible to keep the moisture content of the steam down to 2 per cent and to keep the water level fluctuation confined within 3 to 6 in.

Steam Release and Steam Quality

Steam quality specifications of modern boilers seldom mention moisture content. They invariably call for steam purity in terms of parts of solids per million parts of steam. Modern boilers must produce pure steam. It is not unusual for the steam delivered to contain less than 1 lb of solids per million pounds of steam. The impurities carried away with the steam come from boiler water and they are contained in the moisture of the steam. Because the moisture in the steam is also boiler water, each water droplet is of boiler water concentration.

The 500-hp boiler operating at 150 lb pressure and 150 per cent rating may have a boiler water concentration of 3500 ppm (3500 lb of solids per 1,000,000 lb water). If the steam leaving the boiler contains 2 per cent moisture and this moisture is boiler water, there are 70 ppm of solids contained in the steam (70 lb of impurities per 1,000,000 lb steam). When it is necessary, as in the case of modern boilers, to reduce the steam impurity to 1 ppm, the moisture content will have to be reduced to 1/70 of 2 per cent, or to less than 0.03 per cent, if the moisture is boiler water.

Separation of steam and water in the old type boiler is accomplished mainly by gravity. Some type of dry pipe or separating baffle is generally used, but these devices serve mainly to prevent slugs of solid water from entering the steam take-off. They are not effective for separating finely divided moisture droplets from steam.

It is assumed that the water-carrying capacity of steam increases as the square of velocity and in direct proportion to steam density. If an attempt were made to proportion the steam release drum and steam disengaging surface of a boiler so that steam of 0.03 per cent moisture content is obtained with the same method of gravity separation, an absurd drum size would result. For example, a steam generating unit operating at 450 lb gage pressure and liberating 10,000 lb of steam per hr and per ft furnace width would require a steam release drum over 25 ft in diameter.

Steam Release in the Modern Boiler

With the design used in most modern boilers, the steam generated in steaming tubes of boiler and water walls need not find its way first through the water contained in drums before it can enter the steam release space of the boiler. The tubes are so arranged that all or most steam-carrying tubes enter the steam release drum above the working water level. Steam enters the drum inter-mixed with boiler water and the space above the working level then becomes steam separating space in which the steam can free itself from the water. The water settles out and re-enters boiler circulation, while steam passes on to the take-off. There is no "steam disengagement" from the water level. The water level remains quiet and steady. Rise and fall in water level are not caused by turbulence but only by sudden load changes or by overfeeding and underfeeding. The water level indicated by a correctly connected water gage can then be depended upon as showing the actual working level in the drum.

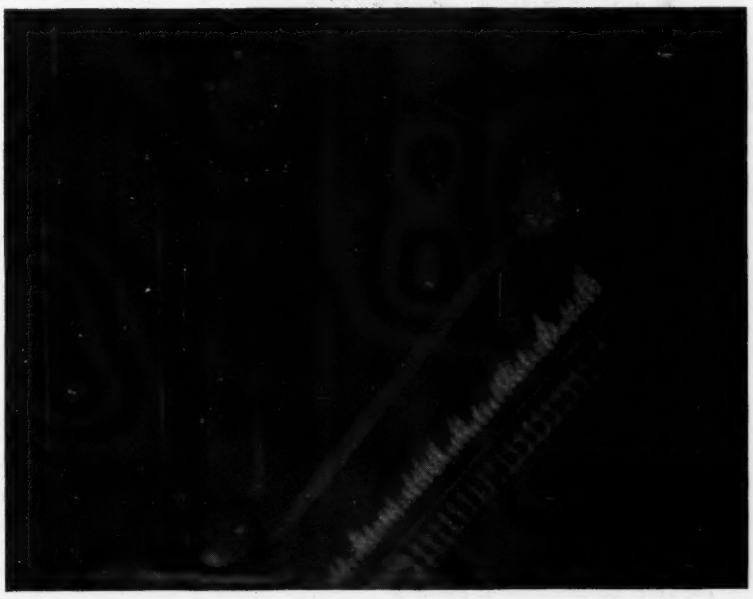


Fig. 3. Glass tube model of 3-drum boiler of present-day design, in operation at same rate of steam generation as Fig. 1, showing steam-carrying tubes discharging ABOVE working water level

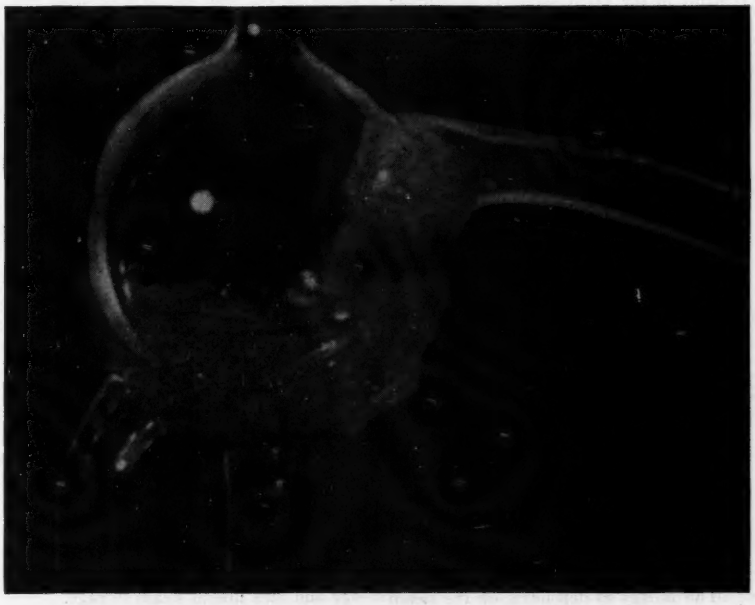


Fig. 4. Close-up of steam release drum of boiler shown in Fig. 3
Note: steam-water mixture entering drum above working level; steam separating in open drum space; steam space clear; quiet, well-defined water level; dry steam discharging through drum nozzle.

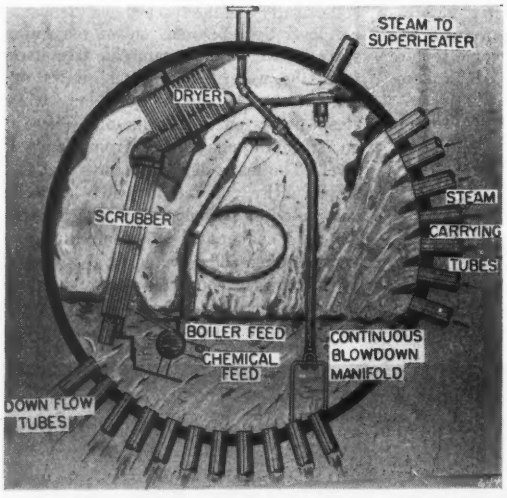


Fig. 5. Cross-section of boiler steam release drum containing installation of one modern type of steam purifier. Part of the steam contacts the cooler feedwater and is condensed. Condensate carried in steam keeps scrubber elements wetted. Solids in steam are deposited on scrubber elements and washed off. Clean steam passes through dryer for final moisture separation. Note the steam-carrying tubes discharging steam-water mixture above working water level and steam disengaging in open space

Steam Purifiers

Modern boilers do not depend on gravity separation for steam drying and cleaning. Most of these boilers are equipped with mechanical steam purifiers. One of the earliest types is the Tracifier. Later developments in cleaning and drying of steam within the boiler employ steam washing with feedwater of low concentration. Others use a scheme in which part of the steam is condensed by direct or indirect contact with lower temperature feedwater. The condensate so formed is used to wash the rest of the steam.

Boiler water of high concentration, carried along with the steam, is exchanged for cleaner feedwater or condensate before the steam passes through a dryer.

The lower concentration of the moisture contained in the steam makes it unnecessary for the steam dryer to be so effective that only 0.03 per cent moisture remains in the dried steam to obtain the steam purity mentioned before. If the solids concentration of feedwater or condensate contained in the steam is only one-tenth of the concentration of boiler water, the same steam purity is obtained with the steam dried to a point where the percentage of moisture remaining in the steam is 10 times greater. Instead of 0.03 per cent moisture, if moisture is boiler water, 0.3 per cent can be tolerated if moisture is feedwater or condensate. The well developed dryers of present day design have no difficulty in drying steam to this extent.

The first question can be answered by saying that "steam disengaging surface" is an obsolete term when applied to modern boilers. Steam is not disengaged from a water surface but is liberated in an open drum space.

Steam Storage Space

It is frequently assumed that the space above the water level of the steam release drum is of value as steam storage and this assumption created the term "steam storage space."

The fallacy of depending on the steam space ot a boiler for steam storage is best illustrated by the following example:

A 100,000 lb-per-hr steam generating unit has a 5-ft diam steam-water drum, 15 ft long. The water level is at the center of the drum and the "steam storage space" represented by the upper half of the drum is 148 cu ft. The boiler unit is operating at 450 psi gage pressure. The specific volume of steam at this pressure is 1 cu ft per lb, therefore the steam "stored" in the drum above the water level is 148 lb.

If all this steam were available at the moment steam generation within the boiler is interrupted, the 148 lb of steam contained in the steam space would continue the delivery of steam, at the rate of 100,000 lb per hr, for only about 5 sec. But to have all this steam available, it would be necessary to drop the pressure in the steam space to atmospheric.

If it were only permissible to drop the pressure to 400 lb, 16 lb of stored steam would be available and it would be a matter of ½ sec until this is used up at 100,000 lb per hr steam output rate. An additional steam receiver drum 5 ft in diam, 20 ft long, having approximately 390 cu ft volume, would provide steam storage for only 2 additional seconds under the conditions mentioned.

So-called steam storage space, if referred to the drum space above the water line, does not serve the purpose the name implies. This space is useful only for the separation of steam and water and for housing the steam cleaning apparatus.

There is, however, steam stored in a boiler but it is not the steam already formed and contained in the steam space. It is the steam which will flash from boiler water in drums and tubes when the pressure is lowered.

Steam accumulators and fireless locomotives work on the same principle. Steam is stored in the water. The greater the water content of a boiler, the greater is its steam accumulator effect. Boilers designed for quick load pick-up are generally equipped with large water drums and headers to provide for liberal water storage and thus liberal steam storage.

Answering the second question, it can be stated that "steam storage space" is a misnomer when applied to the space above the water level of a boiler. This space is not required for steam storage but is important for steam release and steam separation. It would be more correctly named "steam release space."

Height of Steam Take-off

Where steam separation and steam drying are done solely by gravity, the vertical distance between water level and point of steam take-off is of importance. But of greater importance for steam dryness is the velocity of the steam current between the entrance of the steam-water mixture and the point of steam take-off. The higher the velocity the greater is the water-carrying capacity of the steam.

Where the take-off consists of a single steam nozzle or a small group of tubes, less effective gravity separation must be expected than where steam is taken off uniformly over the entire length of the steam release drum, because steam flow velocities approaching point of take-off will be so much higher for the first arrangement than for the second.

Most modern boilers are designed to insure that steam is taken off uniformly over the entire length of the drum. In some of the smaller units, steam is permitted to flow longitudinally through the drum space. With these designs, the largest volume of steam generated enters the steam release drum near one end and is taken off near the other end. The steam flow velocity is low and some measure of separation is assured.

Question No. 3 cannot be answered by stating that for a given pressure and rating the distance between water level and steam take-off must be so many inches. This distance is a matter of basic design of the boiler, the arrangement of the steam cleaning equipment and the expected water level variation in service. The type of boiler water and its concentration and the steam load cycle must be taken into consideration.

Conclusion

Would it not serve the boiler user and the boiler builder better if some of the incorrect terms still in common usage be eliminated in discussing modern boiler practice?

Modern boilers have no steam disengaging surface, they have a working water level.

Steam storage space is misleading if applied to the steam space above the water level. Why not call this steam release space? If some idea of the steam storage capacity, which is the accumulator capacity of a boiler is wanted, the water content to the working level in pounds or cubic feet should be stated.

Height of steam take-off is not as important for successful boiler performance as is the type and design of the steam cleaning and drying apparatus and the velocity of the steam approaching the take-off.

Much misunderstanding can be prevented by using terms which are descriptive of the important elements of boiler design.

Polarized Light Servo-System

A New Servo-system developed by General Electric Co. using plane polarized Light between the primary and secondary mechanisms makes possible the driving of heavy loads with accurate following of primary shaft without imposing any restraint or reaction upon its motion, either in the direction of rotation or axially. It has many possible uses

SERVO-MECHANISMS OR "follow-up" systems are used in many recording and control devices to amplify small forces or torques so that the motion of a heavily loaded output mechanism will correspond closely to the motion of a very low-torque input element. A number of such servo-systems have been developed. Some of these utilize hydraulic principles, others, electro-mechanical principles.

The servo-system described here uses polarized light to link the input and output parts of the system together. It was developed by engineers at the General Electric Co. in connection with the design of electro-mechanical calculating machines. In these calculating machines it was desired to control the motion of an output mechanism to correspond closely to the rotation of a small integrating wheel which rolled on the surface of a revolving turntable.

The requirements, not fully met by any existing follow-up systems, were: First, the follow-up system must impose no load or restraint on either the integrating wheel or its bearings; second, it must permit free axial movement of the wheel; third, it must operate to continuously follow rotation of the wheel in either direction; and fourth, it must be able to follow rapid accelerations and decelerations of the wheel.

To fulfill these requirements, a servo-system was developed which makes use of polarized light as the connnecting link between the input and the output mechanisms. As described in a paper before the American Institute of Electrical Engineers by T. M. Berry of the General Electric Company, the principal of operation of the polarized light servo-system is shown diagramatically in Fig. 1. In this system a small integrating wheel rolls on the surface of a turntable at an adjustable radius (r). Attached to the same shaft (Primary shaft) and rotating with this shaft and integrating wheel, is a polarizing disk or primary polarizer. Two beams of light (A and B) passing through the primary polarizer are polarized similarily, and the plane of polarization rotates as the primary shaft rotates.

A secondary shaft is, in effect, coupled to the primary shaft by means of these two rotating beams of polarized light in the following manner. The two beams of light fall on two phototubes after each has passed through a separate secondary or control polarizer. These two secondary polarizers are attached to the secondary shaft in such a manner that their planes of polarization are at right angles to each other.

When the primary polarizer is oriented so that its plane of polarization is halfway between, or at an angle of 45 deg with both of the secondary polarizers, equal amounts of light will strike both phototubes. If the plane of polarization is not at 45 deg to both secondary polarizers, unequal amounts of light will strike the phototubes. Thus, if the primary polarizer is rotated from balance a small amount in one direction, the light on one phototube is reduced because the angle between the two polarizers in that beam becomes more nearly 90 deg; at the same time, the angle between the planes of polarization in the second beam becomes more nearly zero, with a corresponding increase in light on the second phototube. If the primary polarizer is rotated in the other direction the light beams are unbalanced in the other direction.

The unbalanced output of the phototubes is amplified and controls the speed and direction of rotation of the servo-motor and thereby the secondary shaft and polarizers, keep the light on the phototubes always at or near balance.

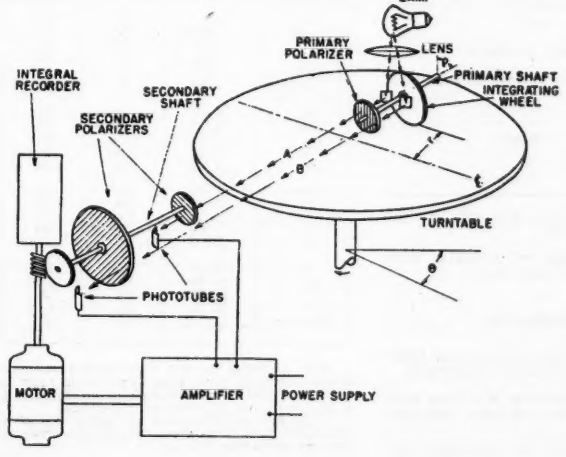
There are four positions of the primary shaft with respect to the secondary shaft where the light beams may be balanced. Only two of these positions, however, will give a condition of stable balance. Once the condition of stable balance has been established it is maintained and the secondary shaft will rotate with the primary shaft in either direction within the allowable limits of speed, acceleration, and load as determined by the motor and amplifier characteristics.

The axis of the primary shaft is held by bearings parallel to the plane of the turntable surface. For changes in radius of contact of the integrating wheel, the primary shaft and polarizer can be moved axially along the two light beams without materially affecting the balance.

Figure 2 is a simplified schematic diagram of the control circuit. The two light beams fall on phototubes P_1 and P_2 which form two legs of a bridge circuit comprised of R_1, R_2, and the resistances of the two phototubes. The voltage unbalance of this bridge is applied between the grid and cathode of vacuum tube (1). This tube together with tube (2) and resistances R_3 and R_4 form a second bridge circuit whose output is applied to the grids of two Thyratron tubes (3) and (4).

The anode currents of the Thyratrons, supplied from the 60 cycle power source through transformer T_2, flow through a split field series motor to control its speed and direction in response to unbalance of light beams A and B.

(*Continued on page* 164)



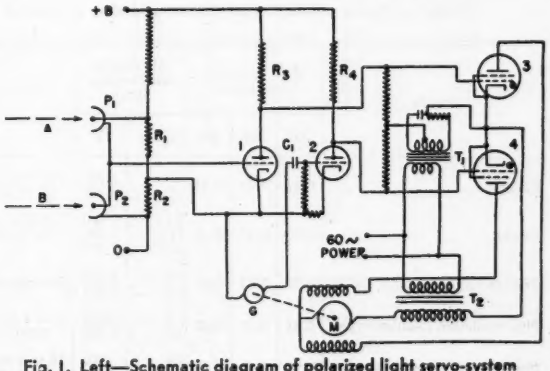


Fig. 1. Left—Schematic diagram of polarized light servo-system
Fig. 2. Above—Simplified schematic diagram of control circuit for polarized light servo-system

INSULATION—
How to Install It

Preparation of surface, details of installation, application of finish, for mineral wool blankets, blocks, insulating cement and pipe insulation for heated industrial equipment

THE FOLLOWING DATA on how to install various types of insulating materials represent recommended practice at the present time. They form the major portion of a recently-published standard on this subject issued by the National Bureau of Standards, U. S. Department of Commerce; the work was undertaken at the instance of the Industrial Mineral Wool Institute. The recommendations have been approved by a large number of users and manufacturers, have just been issued as Commercial Standard CS 117-44, and are effective for new production from May 25, 1944.

It is to be understood that the setting up of these standards is a purely voluntary effort, on the part of all those interested, to establish minimum standards, avoid misunderstandings and provide a basis for certifying quality of material and installation. The U. S. Department of Commerce has no regulatory power to enforce them and the Bureau of Standards merely acts as an unbiased co-ordinator through which all interested parties can agree on the practices found most satisfactory to all.

The standards are written in the form of specifications, which can be incorporated in agreements when desired or can be referred to, and the original text of the standards has been largely retained here. However, the following represents only a portion of the standards and anyone desiring to use them should obtain a complete copy.*

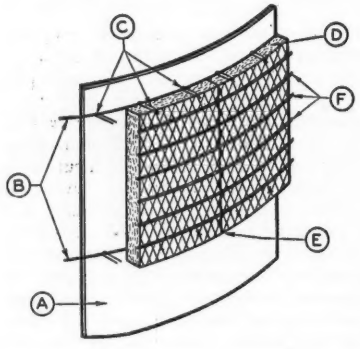


Fig. 1.—Method of securing mineral wool blankets on curved surfaces.

A, Bare surface; B, No. 9-gage galvanized-wire girdles pulled tight around curved surfaces, spaced 4 ft on centers; C, blankets affixed to No. 9-gage girdles with No. 16-gage galvanized hairpin wires, 12 in. on centers; D, blanket insulation with expanded lath side exposed; E, blanket edges laced with No. 16-gage galvanized wires; F, blankets secured with ½- or ¾-in. galvanized bands spaced approximately 8 in. on centers.

The standards begin with a discussion of the requirements for the composition of insulation, its thermal conductivity, denoted by k, in Btu per hr per sq ft per deg per 1-in. of thickness and the maximum temperature limits to be recommended by the manufacturers for various classes of insulation. These data are summarized in Table I. The standard sizes noted are subject to tolerances discussed in the text. Most of the above points are primarily of concern to manufacturers but many must also be taken into account by engineers who write specifications. The standards provide that certain characteristics of the material are to be determined by ASTM test methods readily available in published form.

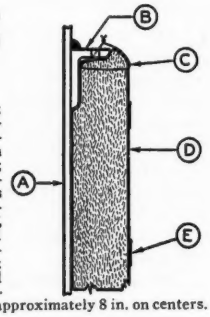


Fig. 2. Alternate method of affixing mineral wool blankets

A, Bare surface; B, punched clip angles welded to surface, spaced 8 ft on horizontal centers; C, blankets hung temporarily from angles with No. 12-gage galvanized wires; D, blanket insulation 1 in. thicker than outstanding leg of angle; E, blanket secured with ½- or ¾-in. galvanized bands space approximately 8 in. on centers.

The following represents recommended installation requirements, based upon long experience, for maximum service in the use of mineral wool products for insulating heated industrial equipment.

Auxiliary Material

Finishing cements may be used to provide a smooth, hard surface over insulating materials in locations not subject to excessive moisture or abrasion.

*A copy of CS 117-44 may be obtained without charge upon written request to the Industrial Mineral Wool Institute, 441 Lexington Avenue, New York 17, N. Y., or from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C., for 10 cents per copy.

Table I.—Types, conductivities, classes and sizes of mineral wool products

Types	k at °F mean temperature			Maximum temperature limit		Sizes
	200	300	400	Class	°F	
Blanket	0.41	0.47	0.53	B	1,000	1 to 6 in. thick by 24 in. wide by 48 in. or 96 in. long.
				C	1,200	
Blocks	0.50	0.53	0.56	A	600	1 to 4 in. thick by 6 in. or 12 in. wide by 18 in. or 36 in. long.
				C	1,200	
				D	1,600	
Cement	0.70	0.75	0.80	C	1,200	Packaged in 50-lb. bags.
				E	1,800	
Pipe insulation (blanket-type)	0.41	0.47	0.53	B	1,000	1 to 4 in. thick by 24 in. long fabricated to fit 2 in. and larger pipe.
				C	1,200	
Pipe insulation (molded-type)	0.42	0.46	0.50	A	600	½ to 4 in. thick by 36 in. long to fit ¼ to 12 in. and larger steel pipe sizes.
				C	1,200	

Table II—Molded-type pipe insulation

Thicknesses [a] for standard-weight steel-pipe sizes

Pipe size		Standard thickness	Double standard thickness
Nominal	Actual O. D.		
in.	in.	in.	in.
¼	0.840	½	1¼
¾	1.050	½	1¼
1	1.315	½	1¼
1¼	1.660	½	1¼
1½	1.900	½	1¼
2	2.375	1½	2½
2½	2.875	1½	2½
3	3.500	1½	2½
3½	4.000	1½	2½
4	4.500	1½	2½
4½ [b]	5.000	1½	2½
5	5.563	1½	2½
6	6.625	1½	2½
7 [b]	7.625	1½	2½
8	8.625	1½	2½
9 [b]	9.625	1½	2½
10	10.750	1½	2½
11 [b]	11.750	1½	2½
12	12.750	1½	3
14 and up	----------	1½	3

[a] In addition to the thicknesses specified above, molded-type pipe insulation may be manufactured in thicknesses of 1, 1½, 2, 2½, 3, and 4 in. for all nominal pipe sizes.
[b] These pipe sizes are no longer listed as standard for steel pipe, Simplified Practice Recommendation R57-32.

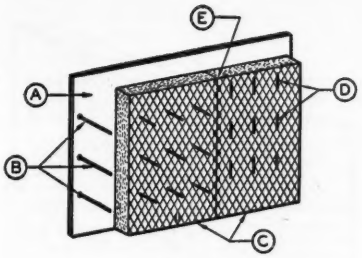


Fig. 3 Alternate method of affixing mineral wool blankets on flat surfaces.

A, Bare surface; B, No. 9-gage galvanized wires of specified length welded perpendicular to surface, spaced approximately 8 in. on centers; C, blankets impaled on No. 9-gage galvanized wires with expanded-lath side exposed; D, No. 9-gage galvanized wires bent up and pressed into the blankets; E, blanket edges laced with No. 16-gage galvanized wires.

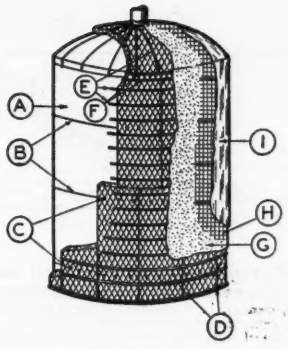


Fig. 4. Application of mineral wool blanket insulation on curved surfaces.

A, Bare surface; B, No. 9-gage galvanized-wire girdles spaced 4 ft on centers; C, blanket insulation 2 ft by 8 ft, wired to girdles; D, blanket edges laced with No. 16-gage galvanized wires; E, ½- or ¾-in. galvanized bands spaced approximately 8 in. on centers; F, two or more bands at top; G, insulating cement; H, 1-in. galvanized wire netting secured in place with No. 16-gage galvanized wires; I, finishing cement or asphaltic finish.

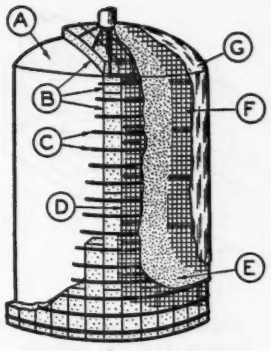


Fig. 5. Application of mineral wool block insulation on curved surfaces

A, Bare surface; B, mineral wool blocks applied with joints staggered; C, ½- or ¾-in. galvanized bands spaced approximately 8 in. on centers; D, 1-in. galvanized wire netting secured in place with No. 16-gage galvanized wires; E, insulating cement; F, 1-in galvanized-wire netting secured in place with No. 16-gage galvanized wires; G, finishing cement or asphaltic finish.

Asphaltic weatherproof finish may be used to provide a water-tight protective finish over insulating materials in locations where excessive moisture or abrasion are encountered or wherever else specified within its temperature limit. This asphaltic finish shall consist of a fibrated asphalt emulsion, which, for weatherproofing purposes, shall be applied to a minimum dry thickness of ⅛ in.

Miscellaneous accessory materials†, such as adhesives, attachment devices, canvas, paper, metal fabrics, asbestos-cement sheets, roofing felt, paint, sheet metal, etc., shall be of a type and quality satisfactory for use in the applications hereinafter described.

Table III—Recommended minimum insulation thicknesses

The insulation thicknesses listed in this table are recommended for indoor locations; for outdoor location increase insulation thickness not less than ½ in. For under ground application, thickness may be decreased ½ in. when specified.

BLANKET INSULATION

Temperature °F	Thickness in.	Temperature °F	Thickness in.
Up to 300	1	700 to 900	2½
300 to 500	1½	900 to 1,100	3
500 to 700	2	1,100 to 1,200	3½

BLOCK INSULATION

Temperature °F	Thickness in.
Up to 200	1
200 to 400	1½
400 to 500	2
500 to 600	2½
600 to 700	3
700 to 900	3½
900 to 1,100	4
1,100 to 1,300	4½
1,300	5

INSULATING CEMENT[1]

Temperature °F	Thickness in.
Up to 200	1
200 to 400	1½
400 to 500	2½
500 to 600	3
600 to 700	3½
700 to 900	4
900 to 1,100	4½
1,100 to 1,300	5
1,300 to 1,600	5½
1,600	6½

[1] Usually applied over blankets and blocks ½ in. thick as a base coat for desired finish. For built-up applications on irregular surfaces, thicknesses may be used up to the practical limit.

PIPE INSULATION

Blanket-type Temperature °F	Thickness: Pipes 2 in. to 4 in.	Thickness: Pipes 4 in. to 6 in.	Thickness: Pipes 6 in. and up
150 to 250	1	1	1
250 to 350	1	1	1
350 to 450	1	1	1½
450 to 550	1	1½	1½
550 to 650	1½	1½	2
650 to 750	1½	2	2
750 to 900	2	2	2½
900 to 1,050	2	2½	3
1,050 to 1,200	2½	3½	4

Molded-type Temperature °F	Thickness: Pipes below 2 in.	Thickness: Pipes 2 in. to 4 in.	Thickness: Pipes 4 in. and up
Up to 275	Std.	Std.	Std.
275 to 350	do	do	1½".
350 to 425	do	1½"	2"
425 to 500	1½"	2"	Dbl. std.
500 to 600	2"	Dbl. std.	Do.
600 to 750	2½"	2½"	3"
750 to 900	2½"	3"	3½".
900 to 1,050	2½"	3½"	4"
1,050 to 1,200	2½"	3½"	4½".

Application (General)

Selection of the economical thickness of mineral wool insulation to be installed is governed largely by the operating temperature maintained, the cost of heat delivered, the number of hours operated per year, and by the effectiveness and applied cost of the insulation. Other factors that determine insulation thickness are the maintenance of precise temperature control; protection against damage by corrosion, freezing, or fire; and personal safety of workmen.

The insulation thicknesses to be applied for various operating conditions

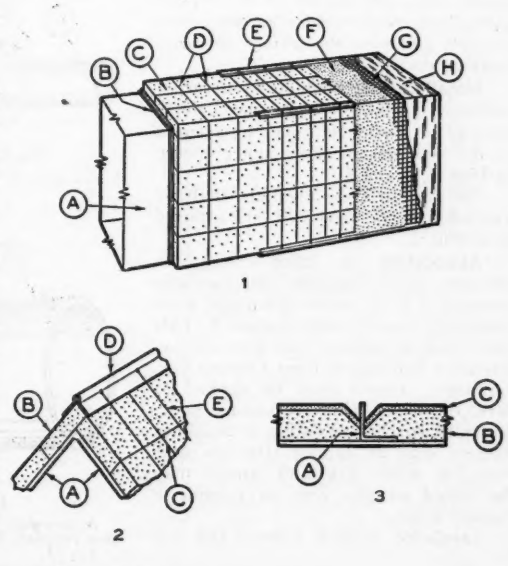


Fig. 6. Application of mineral wool blocks on flat or rectangular surfaces

Sketch 1: Application where insulation thickness is greater than stiffener height. A, bare surface; B, stiffener ribs; C, mineral wool blocks; D, No. 16-gage galvanized reinforcing wires or ½-in. galvanized bands applied over blocks; E, corner bead secured over blocks at corners with No. 16-gage galvanized wires; F, insulating cement; G, 1-in. galvanized wire netting stretched tightly over insulating cement and wired in place; H, finishing cement or asphaltic finish.

Sketch 2: Enlarged details showing application of corner bead. A, metal duct; B, mineral wool blocks; C, No. 16-gage galvanized wire over blocks; D, corner bead; E, No. 16-gage galvanized wires drawn through perforations in corner bead.

Sketch 3: Application where insulation thickness is equal to or less than stiffener height. A, stiffener; B, mineral wool blocks; C, insulating cement and specified finish beveled back at rib.

†During the war emergency period, some of the auxiliary material described in this standard may be considered critical. When such auxiliary materials are not available owing to Government order, an acceptable alternate material shall be used.

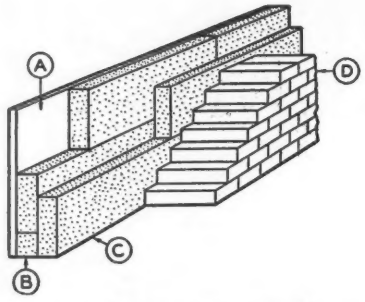


Fig. 7. Application of mineral wool blocks between structural supports
A, bare surface; B, first layer of mineral wool blocks against steel casing; C, second layer of blocks applied with all joints staggered; D, brick.

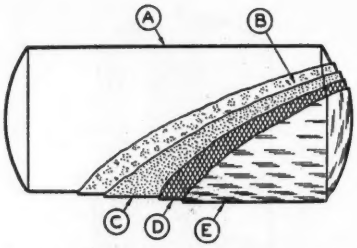


Fig. 8. Application of mineral wool insulating cement on curved steel surfaces.
A, cleaned bare surface; B, first coat of insulating cement spotted on roughly by hand; C, second coat of insulating cement; D, 1-in. galvanized wire netting; E, finishing cement or asphaltic finish.

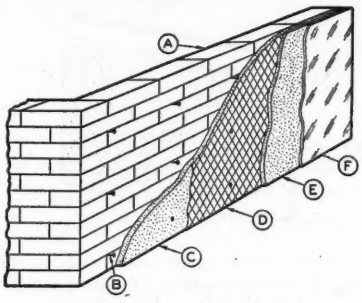


Fig. 9. Application of mineral wool insulating cement on brick surfaces.
A, brick wall; B, masonry nails spaced 8 to 12 in. on centers, extending approximately ¾ in. from bricks; C, first coat of insulating cement applied nearly flush with nail heads; D, 1-in. galvanized wire netting secured to nail heads; E, second coat of insulating cement; F, finishing cement or asphaltic finish.

shall not be less than those recommended in Table III, unless otherwise approved by the purchaser.

External surfaces of heated multilayer brick constructions shall be insulated to a thickness no greater than that which will result in a safe temperature gradient for all materials used in the composite construction.

Expansion joints for insulation shall be provided on equipment operated at temperatures above 600 F, as specified by the insulation manufacturer or by the applying contractor.

Adequate protection shall be provided to prevent the entrance of moisture into the insulating material. Particular care shall be taken around openings and connections.

All mineral wool insulating products and accessory materials shall be installed in a neat, workmanlike manner in accordance with the following recommendations and subject to the approval of the purchaser.

Blanket Insulation

Preparation of surface—The surface to be insulated shall be carefully inspected and all loose rust, scale, or dirt removed and leaks or damage repaired. Suitable anchorage for the blankets shall be provided in the form of wire cables, nuts, clip angles, or No. 9-gage galvanized wires, welded or otherwise, securely affixed to the surface on specified centers.

Installation of blankets—On *curved* surfaces, blankets of specified thickness as in Table III, shall be secured to the supports in the manner shown in Figs. 1, 2, and 4.

On *flat* surfaces, blankets shall be applied with the expanded lath exposed as in Fig. 3.

Application of finish—After the blankets are in position and carefully secured, a ¼-in. layer of mineral wool insulating cement shall be applied. This coat shall be forced well into the expanded metal lath to form a strong key. Sufficient cement shall be applied to level off the surface. A second ¼-in. troweled coat of insulating or finishing cement shall be applied after the first coat has dried. Portland cement may be added to this coat to provide a harder finish.

Insulation located *indoors* and not exposed to moisture or abrasion may be further finished as described below.

(1) When specified, a 6- or 8-oz. canvas jacket shall be sewed or pasted smoothly in place. If sewed, stitches shall be spaced not more than ⅓ in. apart, with seams located where least visible.

(2) When specified, a layer of asphaltic weatherproof finish may be applied instead of canvas. After the second coat of cement has thoroughly dried, 1-in. galvanized wire netting shall be stretched tightly over the surface and wired in place with No. 16-gage galvanized wire. Asphaltic finish shall then be applied sufficiently thick (approximately ¼ in. thick, wet) to provide a minimum dry thickness of ⅛ in., troweling it well into the wire netting.

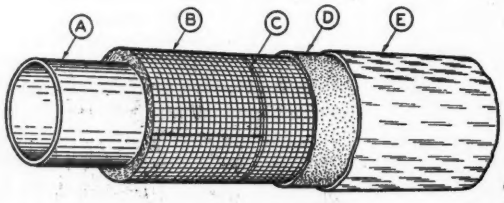


Fig. 10. Above—Application of blanket-type mineral wool pipe insulation on pipes
A, bare pipe; B, blanket-type pipe insulation wrapped circumferentially around bare pipe; C, joints secured with No. 16-gage galvanized wires; D, insulating cement; E, asphaltic or other specified finish.

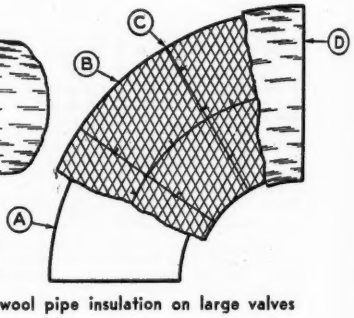


Fig. 11. Right—Application of blanket-type mineral wool pipe insulation on large valves and fittings
A, bare fitting; B, blanket-type pipe insulation; C, joints secured with No. 16-gage galvanized wires; D, insulating cement or other specified finish.

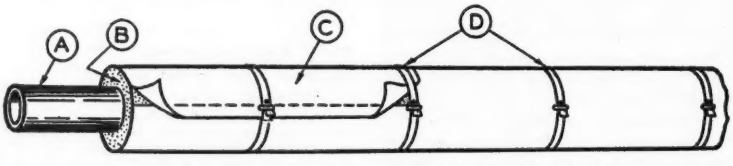


Fig. 12. Application of mineral wool sectional pipe insulation single-layer
A, bare pipe; B, sectional pipe insulation; C, canvas jacket or other specified finish; D, metal bands.

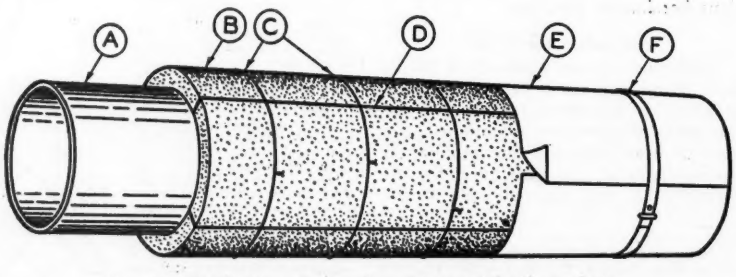


Fig. 13. Application of mineral wool segmental pipe insulation
A, bare pipe; B, segmental pipe insulation; C, No. 16-gage galvanized wires; D, insulating cement when required; E, canvas jacket or other specified finish; F, metal bands.

Insulation located *outdoors* or exposed to moisture or abrasion shall be protected by one of the methods described below.

(1) After the cement has thoroughly dried, 1-in. galvanized wire netting shall be stretched tightly over the surface and wired in place with No. 16-gage galvanized wire. Asphaltic finish shall then be applied sufficiently thick (approximately ¼ in. thick, wet) to provide a minimum dry thickness of ⅛ in., troweling it well into the wire netting.

(2) When specified on smooth regular surfaces, the cement and asphaltic coatings may be omitted, and the surface weatherproofed instead with a sheet-metal jacket. The sheet-metal jacket shall be no lighter than No. 28 gage, single or double galvanized, suitably anchored to the surface. Seams shall be lapped 2 in. against the weather and secured with metal screws, or provided with a locked or flange-crimped joint or otherwise sealed, to prevent the entry of moisture. After providing for expansion and contraction of the metal jacket, it shall be secured in place with ½-in. or ¾-in. galvanized metal bands, machine-stretched and crimped, on specified centers.

Block Insulation

Preparation of surface—The surface to be insulated shall be carefully inspected and all loose rust, scale, or dirt shall be removed and leaks or damage repaired. Brick surfaces shall be made true and even.

Suitable anchorage or support for the blocks shall be provided when required, by securely affixing wire cables, nuts, clip angles, or rods to the surface on specified centers.

Installation of blocks—On *curved* surfaces, blocks of specified thickness (see Table III) shall be applied using staggered joint construction as shown in Fig. 5.

On *flat* surfaces, blocks shall be applied by the methods shown in Fig. 6. When blocks are installed between brick or other structural supports, the anchors, insulating cement, and other finish shall be omitted. See Fig. 7. Finish is to be applied by the same methods given above for blanket insulation.

Insulating Cement (Built-up Applications)

Preparation of surface.—The surface to be insulated shall be carefully inspected and all loose rust, scale, or dirt removed and leaks or damage repaired. Paint or grease shall be removed with a caustic solution which shall then be washed off with water.

Anchorage for the insulating cement shall be provided as required, in the form of clip angles, nuts, rods, or masonry nails of proper size. Additional support is recommended for insulating cement applied on light-gage metallic surfaces, or when surface expansion and contraction is excessive.

When possible, the surface to be insulated shall be kept hot to facilitate drying.

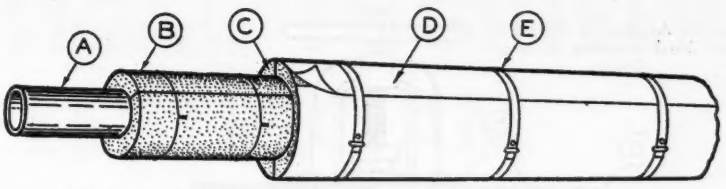
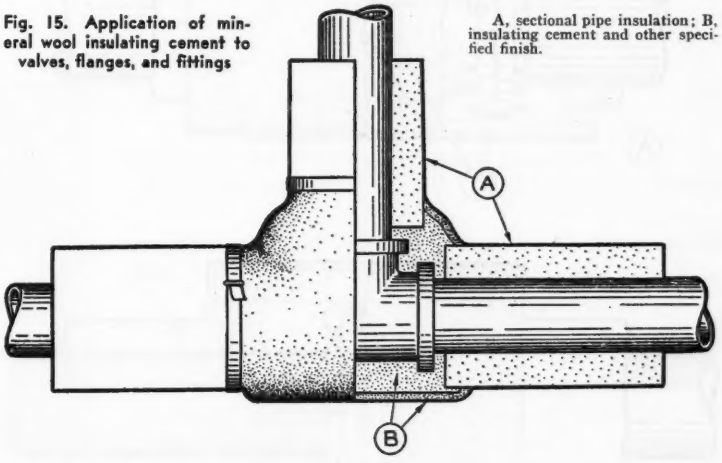


Fig. 14. Application of mineral wool sectional pipe insulation, double-layer

A, bare pipe; B, first layer secured with No. 16-gage galvanized wires; C, second layer applied with all joints staggered; D, canvas jacket or other specified finish; E, metal bands.

Fig. 15. Application of mineral wool insulating cement to valves, flanges, and fittings

A, sectional pipe insulation; B, insulating cement and other specified finish.



Installation of insulating cement—Insulating cement shall be mixed with clean fresh water to troweling consistency before application.

On *curved* or *flat* steel surfaces, insulating cement of specified thickness (see Table III) shall be built up in separate coats not greater than ¾ in. thick as in Fig. 8.

(1) A reinforcing layer of 1-in. galvanized-wire netting shall be applied between every second coat of insulating cement, stretched tightly over the dry cement and securely wired in place with No. 16-gage galvanized wire when: (a) the total insulation thickness specified is greater than 1 in., (b) the cement is to be applied to the underside of equipment, (c) the insulated equipment will be subjected to vibration.

On heated brick surfaces, insulating cement shall be applied as in Fig. 9.

If the insulated surface is to be weatherproofed, No. 16-gage galvanized hairpin wires shall be affixed to the nail heads and permitted to extend through the second layer of insulating cement to provide anchorage for the weatherproof finish.

Application of finish—Insulating cement located *indoors* and not exposed to moisture or abrasion shall be finished, when specified, with a ¼-in. troweled coat of finishing cement. Portland cement may be added to provide a harder finish.

(1) When specified, a 6- or 8-oz canvas jacket shall be sewed or pasted smoothly in place. If sewed, stitches shall be spaced not more than ⅓ in. apart, with seams located where least visible.

(2) When specified, a layer of asphaltic weatherproof finish shall be applied instead of canvas. After the cement has thoroughly dried, 1-in. galvanized wire netting shall be stretched tightly over the surface and wired in place with No. 16-gage galvanized wire. Asphaltic finish shall then be applied sufficiently thick (approximately ¼ in. thick, wet) to provide a minimum dry thickness of ⅛ in., troweling it well into the wire netting.

Insulating cement located *outdoors*, or exposed to moisture or abrasion, shall be finished with an asphaltic weatherproof finish.

(1) A ¼-in. coat of finishing cement shall be applied when specified, to which Portland cement may be added to provide a harder finish.

(2) After the cement has thoroughly dried, 1-in. galvanized wire netting shall be stretched tightly over the surface and wired in place with No. 16-gage galvanized wire. Asphaltic finish shall then be applied sufficiently thick (approximately ¼ in. thick, wet) to provide a minimum dry thickness of ⅛ in., troweling it well into the wire netting. (See Figs. 8 and 9.)

Blanket-type Pipe Insulation

Installation on pipes—Blanket-type pipe insulation of specified thickness (see Table III) shall be applied on pipes and long radius bends of 2-in. diameter or greater.

(1) Before applying, the insulation shall first be formed roughly to fit the pipe. Pipe insulation shall be spaced a sufficient distance from flanges to permit removal of the bolts when flanges are opened. Adjacent lengths shall be butted closely to-

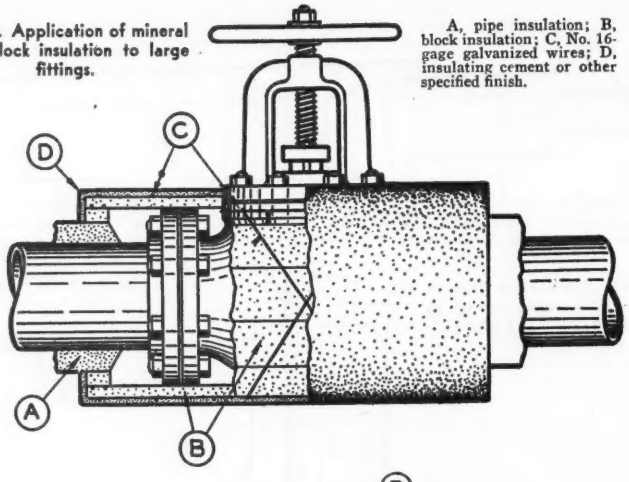


Fig. 16. Application of mineral wool block insulation to large fittings.

A, pipe insulation; B, block insulation; C, No. 16-gage galvanized wires; D, insulating cement or other specified finish.

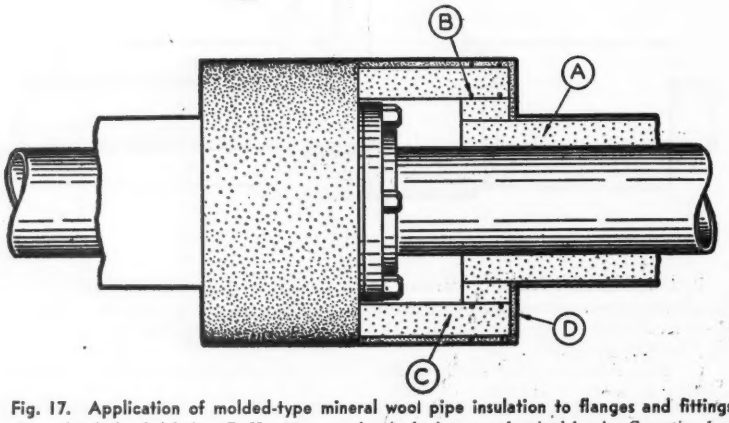


Fig. 17. Application of molded-type mineral wool pipe insulation to flanges and fittings

A, sectional pipe insulation; B, No. 16-gage galvanized wires or galvanized bands; C, sectional or segmental pipe insulation; D, insulating cement or other specified finish.

gether and laced with No. 16-gage galvanized wire. The ends of wire loops shall be bent over and pressed into the insulation to leave no sharp projections. (See Fig. 10.)

(2) When specified, blanket-type pipe insulation shall be furnished with an integral galvanized-metal jacket. It shall be applied snugly around the pipe and bolted along the flanged longitudinal joint. No further finish is required.

Installation on valves, flanges, and fittings—Valves, flanges, and fittings 6 in. in diameter or larger shall be insulated with blanket-type pipe insulation of thickness equal to insulation on adjacent piping. The insulation shall be formed to fit by cutting it along the circumferential edges, then secured in place by wiring the longitudinal joint. All cut edges shall be laced together with No. 16-gage galvanized wire and the ends of wire loops bent over and pressed into the insulation to leave no sharp projections. (See Fig. 11.)

As alternate applications on valves, flanges, and fittings, insulating cement or block insulation shall be used.

(1) Insulating cement shall be built-up in ¾-in. coats to a thickness equal to the insulation on adjacent piping, by the same method as used in Fig. 8.

(2) Blocks of a thickness ½ in. less than the insulation on adjacent piping shall be carefully fitted and wired securely in place. A ¼-in. coat of insulating cement shall then be applied, troweling it well into the cracks between adjacent blocks.

Application of finish—Blanket-type pipe insulation located *indoors* and not exposed to moisture or abrasion shall be finished as described below. (See Fig. 10.)

(1) Pipes, valves, flanges, and fittings shall be finished, when specified, with a canvas jacket sewed or pasted over a layer of flameproof paper, ⅛-in. thick asbestos paper, or a ¼-in. coat of insulating or finishing cement. If sewed, stitches shall be spaced not more than ⅓-in. apart, with seams located where least visible.

(2) Pipes, valves, flanges, and fittings may be finished with asphaltic finish when specified. A ¼-in. coat of insulating or finishing cement shall be applied and when the cement has thoroughly dried, 1-in. galvanized-wire netting shall be stretched tightly over the surface and wired in place with No. 16-gage galvanized wire. Asphaltic finish shall then be applied sufficiently thick (approximately ¼ in. thick, wet) to provide a minimum dry thickness of ⅛-in., troweling it well into the wire netting.

(3) When a roofing-felt finish is specified it shall be smooth-surface asbestos asphalt-saturated, weighing not less than 55 lb per roll of 108 sq ft. Seams shall be lapped at least 2 in. against the weather and when specified, shall be sealed with lap cement. The roofing-felt jacket shall then be secured in place with copper wires or galvanized bands spaced on specified centers.

Blanket-type pipe insulation located *outdoors* or exposed to moisture or abrasion shall be weatherproofed as described below.

(1) Pipes, valves, flanges, and fittings shall be finished with a sheet-metal jacket, roofing-felt, or aspaltic finish, as specified.

(a) Sheet-metal jackets shall be no lighter than No. 28 gage, single or double galvanized. Seams shall be lapped 2 in. against the weather and secured in place with ½- or ¾-in. galvanized metal bands, machine-stretched and crimped, on specified centers.

(b) When a roofing-felt finish is specified it shall be smooth-surface asbestos asphalt-saturated, weighing not less than 55 lb per roll of 108 sq ft, applied as above.

(c) Pipes, valves, flanges, and fittings may be finished with asphaltic finish when specified, applied as above.

Molded-Type Pipe Insulation

Installation on pipes.—Molded-type mineral wool pipe insulation of specified thickness (see Table III) shall be applied in sectional or segmental form, of single- or double-layer construction, as specified. At flanges, pipe covering shall be spaced a sufficient distance from the flanges to permit easy removal of bolts when flanges are opened.

(1) Adjacent pieces of sectional pipe insulation shall be butted closely together and banded in place. (See Fig. 12.)

(2) Segmental pipe insulation should be secured in place with separate loops of No. 16-gage galvanized wire, spaced on 8- to 12-in. centers, depending on the pipe size and insulation thickness. Ends of wire loops shall be bent over and pressed into the insulation, leaving no sharp projections. Insulating cement shall then be troweled well into any cracks between adjacent segments. (See Fig. 13.)

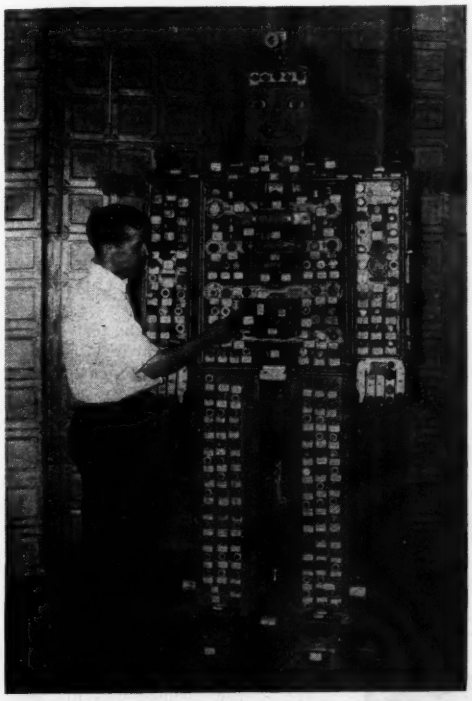
(3) Double-layer pipe insulation, either in sectional or segmental form, shall be applied with circumferential and longitudinal joints staggered, omitting the canvas jacket between layers. The first layer shall be wired in place with separate loops of No. 16-gage galvanized wire spaced on 8- to 12-in. centers. The second layer shall be applied snugly over the first layer and secured in place. (See Fig. 14.)

Installation on valves, flanges, and fittings.—Valves, flanges, and fittings shall be covered with insulating ce-

(*Continued on page* 162)

The PRACTICAL ENGINEER and ELECTRICIAN

ANDREW W. KRAMER, EDITOR



The Fused Man Still Growing

Several years ago, readers of this section may recall the "Fused Man" whom we featured over a period covering a number of issues. The Fused Man is a giant robot type man, built by George Hawkins, an electrician of Brooklyn, N. Y., to display his collection of over 600 electric fuses of all kinds and makes. These fuses were collected and salvaged after years of service on the lighting circuits of many American landmarks of unusual and historical interest. The collection is the only one of its kind so far as is known and was started by Mr. Hawkins about 30 yr ago as a hobby. **(Continued on page 114)**

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Conversion From Oil To Coal Without Removing Oil Burning Equipment

By LT. COL. HAROLD G. BURRILL
Ordnance Department, Aberdeen Proving Ground, Maryland

IN THE SUMMER of 1942 there was every evidence of a shortage of fuel oils of all types throughout the United States. This would effect government installations as well as industrial plants.

Aberdeen Proving Ground had, among 27 other oil burning plants, a large central heating plant supplying a group of large buildings which burned well over 700,000 gal per heating season. This plant consists of four 300 hp Heine boilers set in battery generating steam at 150 psi. The original installation was made in 1917 with hand fired grates which were taken out after about 18 yr and Detroit underfeed stokers were installed.

In 1941-42 a Peaboby oil burner system was installed complete with 100,000 gal surface storage tank, pumps, heaters, etc. Each boiler was equipped with two burners of the high pressure forced draft type having sufficient capacity to drive the boiler up to 200 per cent rating. Bunker C (No. 6) or heavy fuel oil was indicated, so proper steam and electric heaters for oil were installed to heat the oil for proper atomization. All burners were equipped with double or forced draft windbox fronts with Carling steam turbo-blowers as a supply for forced draft. Plans called for use of forced draft at ratings above 150 per cent. The furnaces were refractory lined with burners located under the high end of the boilers and placed about three feet above the furnace floor. The size of the furnace was 9 ft high (7 ft high at rear end) by 8 ft wide and 16 ft 7 in. front to rear wall, or approximately 1,050 cu ft furnace volume.

At 200 per cent rating a heat liberation of approximately 18,000 Btu per cu ft would occur, which on oil is low enough for good furnace wall maintenance.

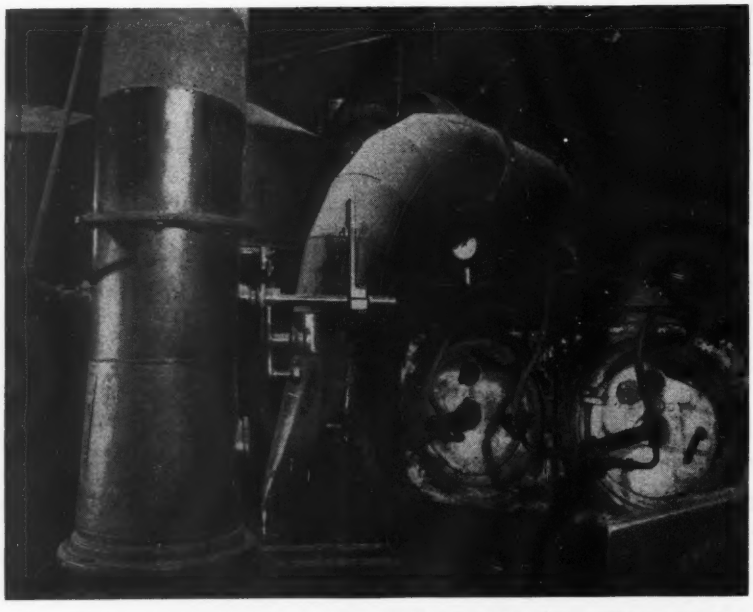


Fig. 1. Showing clearance between coal and oil burners with Carling steam turbine driven forced draft blower shown above pulverized coal pipe elbow

When orders were received to convert to coal, several factors had to be considered. One, speed of conversion; two, materials and equipment available; three, suitability of boilers for coal burning at high ratings; four, ability to get coal of suitable size, type and in sufficient amounts.

Stokers had been suggested for this and other government installations and some were installed at nearby government plants.

Analysis of boiler setup, boiler house, coal and ash handling problems, plus additional boiler rating to be carried, indicated that stokers with ash pit requirements, bridge wall, etc., would be more costly to install than pulverized coal.

When oil burners were installed, the Detroit underfeed stokers were removed along with the bridge wall. The ash pit and rear cleanout pit were floored over and left at substantially the same level. This meant that the shape of the furnace was low on the rear end and high on the front end, which required installation of burners having relatively flat low flames.

To lower and enlarge the furnace would have required the cutting out of very heavily reinforced concrete made primarily of concrete and old railroad rails. The cost of removing this material would have been greater than the saving that could be effected by the slight increase in furnace volume. Figure 1 shows just how the oil burners were installed.

From Fig. 2 it can be readily seen that to install coal burning apparatus of the stoker type without materially destroying or disturbing oil burners, etc., presented quite a problem—so, pulverized coal was finally decided upon.

Duplex burners handling both oil and coal were first considered, but upon investigation it was felt that with the existing pressure type forced draft oil burners a plain type pulverized coal burner would best handle the widely varying loads, different types of coal and different amounts of coal consumed in conjunction with oil burners.

The next problem was to find a suitable location for the pulverized coal burner in the front wall of the boiler located as not to disturb the oil burners, forced draft front, etc. This burner could be installed above and between the oil burners in a normal installation but in this case brought the pulverized coal flame too close to the bottom row of boiler tubes. Several layouts were tried and it was finally decided to place the pulverized coal burner above and between the present oil burners but tilt the burner five degrees downward so that the center lines of the three burner flames would intersect in a horizontal plane in the center of the furnace. In selecting this location the horizontal baffles of the Heine boiler were kept in mind in that the gas travel was toward the back of the boiler furnace, not forward as in vertically inclined baffles; so that the tendency was toward long narrow flame.

Strong-Scott pulverizers were selected due to size, availability and cheapness of renewable or wearing parts and the fact that no magnetic separator was necessary. One pulverizer per boiler was selected having a normal capacity of 1200 lb coal per hr and a maximum of 1320 lb per hr corresponding to a heat liberation of 12,800,000 Btu per hr corresponding to a little over 150 per cent rating. While theoretically not large enough for a boiler of this size, a small pulverized coal burner was selected which actually handled loads in excess of 150 per cent rating when the coal was dry. On heavy peak loads oil was turned on for an hour or more to boost the pressure when only three boilers were on time.

Installing the pulverized coal burner required dismantling part of the front wall brickwork and relocating the Carling steam turbo-blower to one side in the then forced draft front windbox, which did not alter its efficiency or mar the appearance of the installation.

Coal was stored outside the boiler room wall and carried in through a doorway to each pulverizer by using shovel and wheelbarrow. Each unit pulverizer coal hopper holds 500 lb of raw coal which was sufficient to supply the coal feeder or the pulverizer and hold enough coal for drying while the supply was replenished by hand shoveling.

Ash handling was accomplished by providing doors at floor level for clean-out purposes and allowing the heavier ash particles to accumulate until the weekend when the furnaces were cooled down and cleaned out. On coals having less than 10 per cent ash no trouble was experienced in running one week or more on one cleaning. Fly ash gave no trouble except some accumulated on the edge of the horizontal baffle and was readily blown off with a steam or air lance. Stock discharge of fly ash is relatively small and causes no trouble in spite of being surrounded by residential and industrial buildings.

During mild weather with some oil available, the morning heating load peak was carried by coal and after the peak load fell off oil was used to occasionally increase the pressure. However, during periods of extreme oil shortage the pulverized coal units carried the light as well as the heavy loads.

The pulverized coal burner was installed so that forced draft could be supplied to it as well as to the oil burners, but subsequent operation proved that natural draft provided all that was necessary.

Ignition or lighting off was accomplished by lighting off one of the oil burners and operating it long enough to heat the brickwork sufficiently to maintain ignition for the coal burner.

Control of the coal burner and pulverizer was transferred from the oil burner control which was designed by Hagan Corporation. No stack draft control was provided at the time, although it had been on order for some time. Operation of pulverizers was not affected by the lack of this control except on very light loads or below 5000 lb steam per hr when with excessive stack draft the burner had a tendency to snuff out or pull the flame

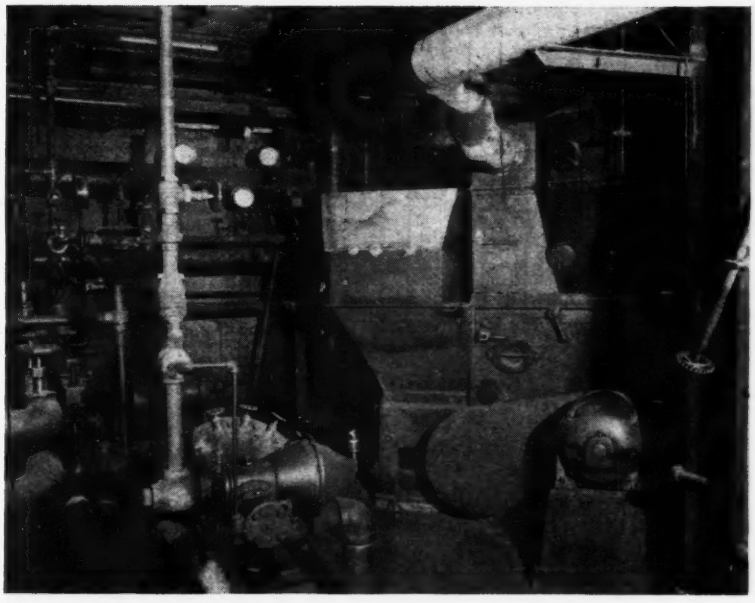


Fig. 3. Fuel oil pumps and heaters located in opposite end of boiler room with No. 1 coal pulverizer in right foreground

Fig. 2. Showing location of pulverizer on boiler room floor in relation to oil burner and forced draft boiler front, also motor driven boiler feed pump shown on platform in upper left hand corner

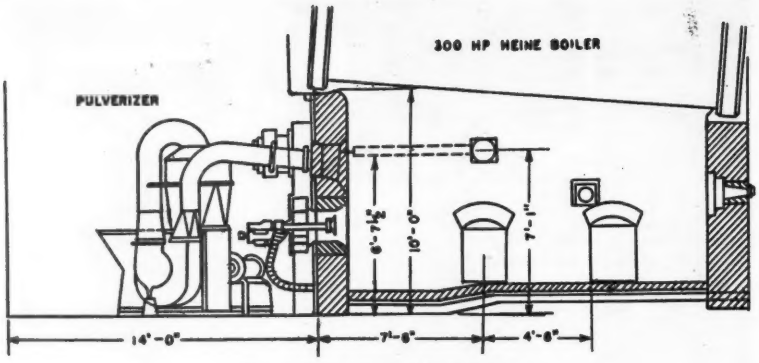


Fig. 4. Section through boiler No. 1

away from the burner on quick change of loads.

The installation as shown in Fig 2 indicates both oil and coal units ready for service. Figure 2 shows boiler feed pumps arranged out of the way on a platform 8 ft above the boiler floor but in sight of the fireman at all times. On a platform above the pump platform is the deaerating feedwater heater and make-up control receiving all returns from the condensate system and adding make-up as required. The distance from the top of the water in the feedwater heater to the center line of the centrifugal pumps is 15 ft, which gives sufficient head on the suction side of the feedwater pumps to prevent vapor lock in the pump with feedwater at high temperature.

One pump is motor driven and the other turbine driven. These are operated in accordance with the demand for exhaust steam in the heater. Generally, however, the returns are hot enough, in that, only a small amount of additional exhaust steam is required.

The feedwater control consists of equipping both pumps with Fisher excess pressure governors and Copes feedwater regulators installed on each boiler so that minimum labor is required for maintaining water level in boilers. Figure 3 shows the oil pumps and heaters mounted in the boiler room and near No. 1 boiler. Figure 4 and 5 show drawings, giving relation of burners and other equipment.

The winter heating season of 1942-43 indicated the wisdom of maintaining equipment suitable for burning both types of fuels, in fact, during periods of coal strikes, frozen coal, sleet, ice and other problems, fuel oil carried the load through many peridos, although it was used for a relatively short time.

The entire job was handled by the writer through MacKenzie Engineering Co., who are factory representatives of both Peabody Burner Co. and Strong-Scott Manufacturing Co.

The brickwork alterations were done by George H. Dashiells and Sons, Baltimore, Maryland. Pipe work and other installations were done by MacKenzie Engineering Co.

The entire job was completed in about eight weeks after material arrived. The operation of this job indicates that while it was satisfactory for the emergency in view, and operated very well in moderate boiler ratings, large furnaces with higher settings would have been helpful in many ways. Two years operation, however, indicated that, other than slight slagging of the brickwork at the points where the three burners came together and an accumulation of fly ash toward the end of the week on the end of the horizontal baffle, the unit worked out very well.

This article, however, is not to be construed as advocating or recommending the installation of such units under boilers set as low as indicated in this article, nor with the baffle arrangement as shown. However, the writer being the officer responsible for providing heat made it necessary to find quick relief in some manner by providing an additional type of fuel with the result as indicated.

Safety Regulations for Lathe Operators

TWENTY REGULATIONS for safe operation of lathes are contained in a small pamphlet prepared for distribution by foreman to lathe operators at General Electric's Schenectady Works. The front of the pamphlet carries the admonition: "If you don't know the safe way, stop and find out. It's a lot easier to do things right than wrong—and a whole lot safer."

The twenty regulations, approved by the Works' Safety Committee, are as follows:

Before Starting Lathe

1. If there are red, green, or yellow tags on the machine, do not move the control handle or switch.
2. Use a soft hammer to hit hardened tools—never a hardened hammer.
3. Put chuck or face plate on lathe spindle by hand, not by starting the lathe.
4. Remove chuck wrenches from chuck before starting lathe.

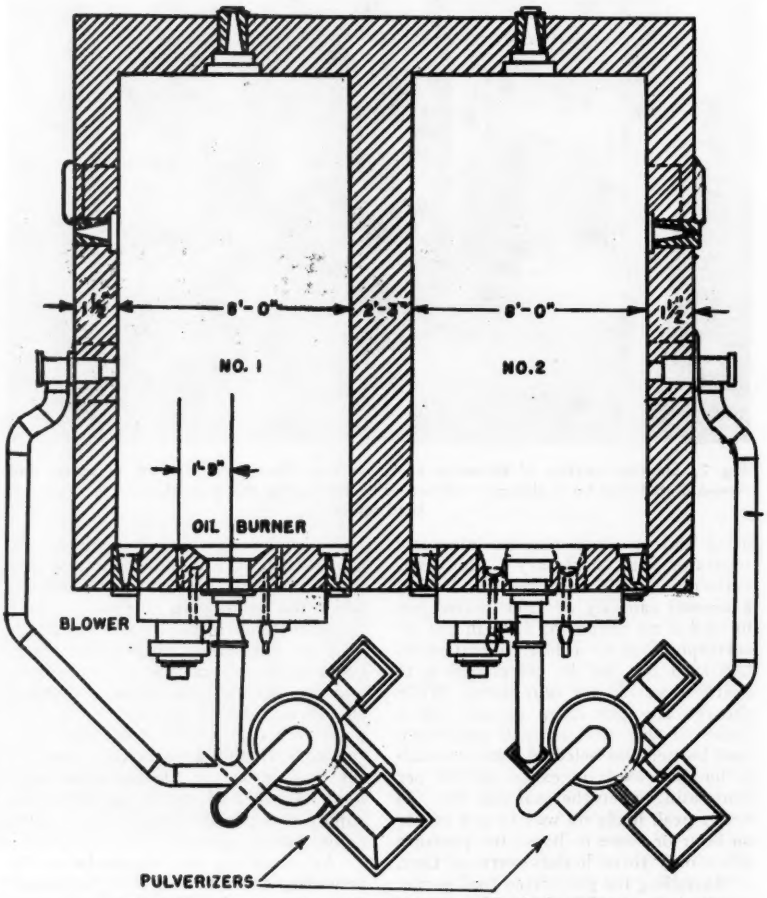


Fig. 5. Plan showing pulverized coal burner and Peabody oil burners

5. Make sure setscrews do not project from rotating parts.

6. Before starting lathe, see that all guards which have been removed are replaced.

7. Operators must not remove or make ineffective any safeguards unless specifically authorized to do so by the foreman.

8. Loose clothing, hair, neckties, long sleeves, and wiping rags might catch in revolving work. Wear proper clothing and exercise great caution when working with revolving machinery.

9. Always remove tailstock center when not in use.

While Lathe Is in Motion

10. Never attempt to change speed of an engine lathe while spindle is in motion.

11. Beware of sharp burrs on chips or spiral chips which may snap around.

12. Make sure all files are equipped with handles.

13. When using emery cloth on revolving work, be careful that the cloth does not overlap. This can be avoided by applying the emery cloth with a flat file or piece of wood.

14. Use a *brush, hook,* or *special tool* to remove chips.

15. Do not use a micrometer on revolving work.

16. When grinding or turning brass, textolite, or any material which may release flying particles, *safety goggles should be worn.*

17. Stop lathe when oilling, cleaning, or repairing it. Open the switch when making adjustments.

18. Do not stop lathe chuck with hand.

19. When a heavy chuck is on the lathe, do not stop the spindle suddenly or the chuck may fly off.

20. Do not leave the lathe in motion unattended.

How to Maintain Oil Circuit Breakers

By N. P. Wilson
Engineering and Service Department
Westinghouse Electric & Mfg. Co.

TO PREVENT costly failures and delays in operation, it is important for the starting breaker to function properly when an emergency arises. To accomplish this reliability, it is necessary that the breaker receive periodical thorough inspection and maintenance.

Motor starting, oil circuit breakers are designed for general starting service. When properly applied they protect the motor from overloads, short-circuits and guard against the sudden application of full voltage to the motor after it has come to rest.

The frequency of inspection and maintenance depends upon the severity of the duty which the breaker must perform and the condition of operation. Usually a light monthly inspection with a thorough inspection and maintenance semi-annually should be satisfactory. However, in some cases breakers operating under very active and severe service may require more frequent attention. Other breakers that operate infrequently, and under less severe duty, will naturally require less attention. The frequency of inspection will be largely determined by experience.

Ten Points to Check for Proper Maintenance

1. Before making any adjustment to an oil circuit breaker, make sure that all lines leading to it are electrically dead.

2. Be sure the breaker frame is grounded.

3. Do not operate the breaker excessively by the electrical operating mechanism when the oil tank is removed.

4. Examine all contacts frequently, especially after severe short circuits, to see that contacts are properly aligned. Dress or replace contacts that are burned.

5. After making adjustments, test the breaker by hand to make sure that it operates smoothly and correctly.

6. Inspect the oil regularly and after severe short-circuits. If it shows signs of moisture, carbonization or dirt, filter and retest it before replacing it in service. See that the oil level in the tanks is maintained at the proper height.

7. Remove all oil and thoroughly clean the tanks, tank liners, lift rods, and terminal bushings at least once a year.

8. Thoroughly inspect all bolts and nuts; tighten if necessary. Inspect all pins, links and bearings for excessive wear. Check all cotter pins.

9. Dielectric tests of the oil should be made every three months, to show if it is reasonably good for circuit breaker work. Samples should not be taken until the oil has remained undisturbed for at least four hours. If testing for indication of water, take the sample from the bottom of the tank. For indication of carbon and after a heavy short-circuit, take the sample from the surface of the oil.

10. Arrange for regular inspection to see that the circuit breaker is in adjustment, the oil of good quality, and the complete breaker functions as required.

Revised Water-Feeder

By J. R. Kennedy

"WHAT IS THIS FOR?" I asked the operator, pointing toward a large can and pipe located at one side of a large gas-, kerosene-, or (cheaper fuel)-burning engine.

"That is a revised water-feeder, home-made in this case. I couldn't get

"He wants to know can he keep his lunch box in the safe until noon. He has a steak sandwich in it."

along without that, because it saves so much time," the operator replied, motioning for me to come closer.

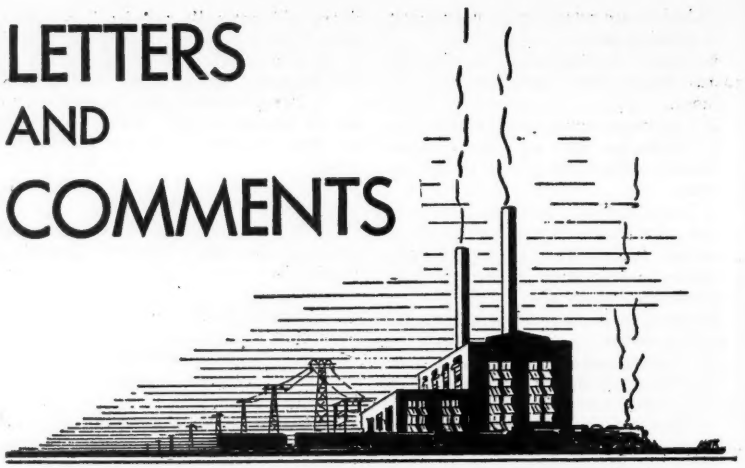
"What is the purpose of a water-feeder on an engine, and why did you find it necessary to revise that feeder?" I asked, after examining it more closely to determine just how it worked.

"You see in burning kerosene and other cheap fuels, particularly tractor fuel, one has to mix in a little water with the fuel to prevent the engine from becoming too hot and 'pounding'. As put out originally by the manufacturer, this engine was equipped with a water-feeder supplied with water from the cooling hopper; but this proved to be an endless source of trouble because I could adjust the 'feeder' to release the proper amount of water while the engine was practically cold prior to the heat-up period and it would work nicely for a while; but when the engine began to warm up there would be a great fluctuation in the feeding, sometimes too much, sometimes too little, and sometimes apparently none at all. I found it impossible to adjust the feeder to feed properly when the water was boiling actively in the cooling hopper, no matter how often I made adjustments to take care of changing conditions. Although the hopper is open at the top, the boiling produced changes in the water 'pressure,' causing very erratic feeding. Sometimes I could see steam in the sight-feed glass."

"Quite a simple outfit," I replied, as it consisted of a large can on a simply-constructed rack or shelf on the side of the engine, a short nipple soldered in the side of the can at the bottom; then a tee with another nipple onto which had been screwed a valve to provide drainage when not in use in freezing weather; and getting back to the main line, another pipe reached from the drain tee to the sight-glass-equipped water-feeder. A needle valve in the water-feeder provided a means of cutting off or adjusting the flow. The bottom of the can was, of course, on a level with the inlet in the water-feeder proper.

"You see," continued the operator, "the water in this can never boils and when I adjust the water-feeder to put in the proper amount, I can forget about it for sometime; but even then a little more water may be required after the engine reaches its heat peak, making another adjustment necessary. However, I can depend upon this feeder because it is not subject to the capricious feeding caused by boiling water in the old type of feeders. This water-feeder saves time, temper, fuel (I believe) and most of the pounding and stalling I experienced in the past. I am not troubled by changes in temperature, pressure, or fluctuations in amount. All that is required is to keep the can filled with water; and this valve and tee provide drainage in freezing weather."

LETTERS AND COMMENTS



The Boiler Operator — The Forgotten Man

An old engineer once told me that a fireman was a man with a strong back and a weak mind and that anyone could operate a turbine as there was nothing to do because no moving parts could be seen.

I call this statement to your attention as I want you to think of it while reading this account of some of my findings, which are primarily from a powdered fuel, unit fired boiler room of a public utility station but nevertheless will hold good in any boiler room.

I had not intended to express my views until I read December issue of Power Plant Engineering and found Andrew Kramer's article entitled, Million Dollar Plants Vs. $1500.00 Men. I agree with Mr. Kramer in every respect but will go further and state that too often men above the $1500.00 bracket are not allowed to exercise their knowledge or are discouraged to the point of carelessness due to personalities and too often existing conditions in power plants.

It has only been in the last decade that some of the larger companies have realized the importance of well educated and highly trained operators. In fact, at present some companies are hiring only college graduates to operate their boilers and turbines or men with equivalent practice and home study, who compare favorably with men who have a college degree. In order to obtain this type of operator, it is true that wages of the operator have advanced but not to the point where it makes a lucrative proposition to college graduates, unless higher positions will in the next few years become filled with young men and either the wages will have to be advanced or the college graduate will feel he can find better employment elsewhere. I believe the raising of the standards of operators is a real step toward safety and economy in operation, but I also believe it is hampered in a number of plants by a vicious cycle which I shall try to set forth.

The encouragement of department heads to operate their departments so that the monthly cost sheet will reflect favorably on themselves without regard to other departments is a vicious cycle.

I shall attempt to give a few examples to show the never ending cycle of such practice. The master mechanic repairs a coal mill with these thoughts in mind, to keep the cost of grinding low, to obtain maximum hours from equipment and just enough fineness to pass a test if one is given. Not much thought is given the preservation of thermometer couplings and control lines or the capacity of the mill. Oftentimes the mill may contain badly chipped grinding rings due to previous changing of poorly fitted balls or may contain balls with flat spots or balls of different sizes.

The boiler room engineer has his boiler makers repair a boiler with these thoughts in mind, to place the boiler in repair and in service at the lowest cost and the shortest possible time. These men, during their repair, step on and break control lines and draft gage lines, causing gages to become useless until repaired. The boiler may be placed in service with two or three soot blowers out of service. These soot blowers may be replaced after 24 to 72 hr continuous service and after the boiler has already become partially clogged from lack of proper cleaning equipment. There is usually found slight leaks in draft lines or control lines caused from abuse. Then again exhausters and fans may be allowed to run while out of balance, causing terrific floor vibration and in turn shaking draft gages, flow meters, ammeters and other gages until they become inaccurate or useless.

Meanwhile the instrument repair men in the station are busy repairing broken lines, leaking lines and correcting gages, which have been worn out by vibration or broken by carelessness. They, too, say, "What's the use, we can't keep up and why should we repair equipment when others have no respect for our equipment?" This may seem to be the end of this vicious cycle but the operator is yet to be considered. Who suffers most from this cycle? The operator on whose shoulders rest the economic operation of the boilers. In case of slag tap bottoms the boiler operator is expected to keep his fire low enough for proper tapping of the slag and also to adjust his fire so as to keep undue slag from generating tubes

of the boiler and undue flame concentration on boiler walls. All this he strives to do and maintain maximum rating on his boilers regardless of mill conditions. No boiler operator can properly adjust his fire when he is forced to use excessively high burner box pressures to obtain high primary air pressure to his coal mills in order that maximum mill capacity may be had.

In striving to do all this, he may find only part of his gages in working order, also he may even have difficulty in getting his control lines blown out once in 24 hr as plant rules may forbid him from performing this task. He finds it difficult to learn of what repairs are being made to equipment he is operating or he may even be denied the knowledge entirely. Repairs and changes are made which effect his operating by men who do not operate and will not have to operate the equipment, yet he is seldom consulted as to the handiness, effectiveness and efficiency of the added changes. I have known boiler operators who, on inquiring what repairs were being made on coal mills, were told that the balls were being oiled. Yet this boiler operator is at the mercy of all load demands and all operating errors of the switchboard operator coupled with loss of station load, due to mechanical failure and electrical storms. He is expected to maintain a good steam chart, perform efficient boiler operation and remain calm. This is the end of the vicious cycle for he too becomes disgusted, careless and wonders why he should be the final goat for every department's cost sheet.

I wonder when all companies are making every effort to school their employees through home study courses if they are getting full benefit from these courses or whether we are again returning to the old engineer's statements made at the beginning of this article.

Will some one better informed set me right or am I wrong?

Pekin, Ill. VANCIL F. HILL

Tricks for Doing Tough Jobs

THE ARTICLE "Tricks for Doing Tough Jobs," by J. R. Kennedy, on page 95 of the June issue, brings to my mind some methods for doing similar jobs which I have found to work well.

Quite often a job will come up where a pipe is broken off close to a cast iron fitting, or a fitting must be saved where the pipe is stuck so tight it will not come loose by heating, and cooling the pipe,

I use the oxy-acetylene cutting torch, cutting the pipe off about one-quarter inch from the face of the fitting. Then, holding the torch nearly parallel with the pipe, I start a cut at the end and follow straight in, cutting the whole length of the piece left in the fitting. The pipe is not very thick at the base of the threads, and it will be found that a section of the piece is burned out without damaging the threads in the cast iron fitting in the least. Then it is an easy matter to collapse the piece with a hammer and blunt chisel and remove it.

Another job that is made much easier by using the cutting torch, is cutting off large pipe when no machine is available. Start the cut with an ordinary wheel cutter, until a distinct mark is made all around. Then, using the torch, start a cut at the outer edge of the mark and follow around the pipe. It will help if the pipe can be turned slowly while making the cut, as then the position of the torch can be held steady. A few taps with a hammer will remove any icicles that may be left on the inside, and the pipe is ready to thread as soon as it is cool.

If the pipe is to be welded, the same method can be used, except hold the torch at an angle so as to make a tapered cut. Then when the pipe is in position for welding there will be a V in which to get a full depth weld.

Dalton, Mass. FRED E. GOULD

Regulating Sulphuric Acid Feed

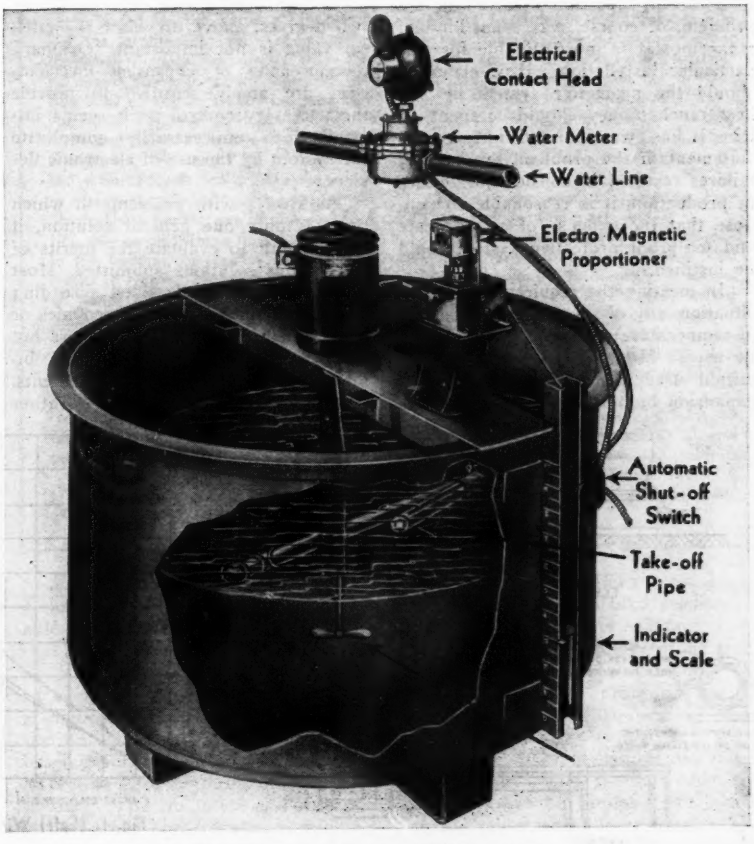
WE HAVE NOTED with a great deal of interest the solutions to the sulphuric acid feed problem (No. 33) presented in the May and June issues of POWER PLANT ENGINEERING and thought that you might be interested in a copy of of our bulletin "Corrective Chemical Feeding" which we are sending you. This bulletin illustrated a method that we have been using for more than 15 yr and which resembles Mr. Caleb's solution on page 99 of your June issue, as you will note. (The accompanying illustration, taken from this bulletin, shows this arrangement.)

We prefer to get our impulse from a meter, although it can be obtained from a pump or any other device which measures water. The meter is a more universal and generally accepted method of measuring water. We also use this impulse to operate an electric solenoid, not only to effect remote control but to eliminate the necessity of any actual power being furnished by the contact-making device. Finally, we run our ratchet in oil so that there is very little wear and tear and which enables us to make a 5-yr guarantee on the operation of the equipment. The stroke of our solenoid is variable to increase or decrease the flow.

We lower a spout on the outside of the acid tank in exactly the same way as suggested. The crock type feeders shown in our bulletin are made in exactly this way. However, we have a sight-feed indicator on them to show the amount of chemical being fed.

As the proportioners are manufactured in large quantities, the cost of this equipment is very low, indeed, and it is our honest opinion that anyone desiring to feed sulphuric acid accurately and in proportion to a variable flow, could purchase this equipment for much less than it would cost him to rig up something of his own.

H. C. WAUGH, Vice President
American Water Softener Co.
Philadelphia, Pa.



Type HSA Feeder of the American Water Softener Co.

How Would You Do It?

Problem 35. The Case of the Hot Bearings

FOR SOME peculiar reason hot bearing seem no great mystery to the readers of this section of POWER PLANT ENGINEERING. The fact that Our Hero could not solve this problem himself simply proves that which we have contended all along, namely, to wit and ergo, that Our Hero is just a plain dope. How else would you detect a hot bearing except by hooking a thermometer or thermostat of some kind on it? Perhaps the simplest thermometer would be to have Our Hero sit on the bearing—he doesn't seem to be much good for anything else; nobody suggested that, however.

The only question involved in the problem, of course, was, what kind of a thermostat is most suitable for this particular installation? How elaborate should the protective system be and how much money should be spent on it? If, as was pointed out in the statement of the problem, the bearing failures resulted in considerable losses in production, it is reasonable to suppose that the expense of an adequate and foolproof protective system could be justified.

In meeting the requirements of the situation, any of several different types of temperature measuring methods can be used. Most of the solutions submitted used either thermocouples or expansion bulb type of thermometers.

As in all problems of this character, the sensitivity of the protective system should be taken into account. Several of the contestants submitted solutions involving the use of electron tubes, some in conjunction with thermocouples, others employing resistance coils. Systems of this kind are perfectly feasible but the use of electron tubes can hardly be justified in this case because the degree of sensitivity required is only of a moderate order. Electron tubes are useful in the measurement of extremely small temperature changes but in the case under consideration, whether the alarm or other signalling device cuts in one or two degrees, above or below the critical value is not important. Ordinary thermocouples or expansion thermometers are amply sensitive to provide the necessary control so it seems imprudent to unnecessarily complicate the system by the use of electronic devices.

As always with problems to which there is only one general solution, it was difficult to evaluate the merits of the various solutions submitted. Most of them could be classified according to whether they used thermocouples or expansion bulb type thermometers but there were a number that used bimetallic type thermostatic elements.

Some contestants designed rather elaborate home-made equipment, very ingenious but quite unnecessary in view of the fact that extremely simple arrangements would serve just as well.

After examining all the solutions submitted carefully and analyzing them from every standpoint, we had no alternative but to award the first prize to C. G. Clark who has won a number of awards for his solutions to previous problems. Although others also recommended the use of thermocouples as does Mr. Clark, his analysis of all conditions of the problem and his recommendations are so complete, that there was very little question about his winning the first award. As will be noted, Mr. Clark not only suggests the use of thermocouples but lists various other types of solutions as well including the use of a fusible link. The latter is a very simple yet practical arrangement that very few of the contestants touched upon. Furthermore, Mr. Clark shows calibration curves for three different metal combinations in making up thermocouples and also tells how to check their characteristics. In short, he not only shows how the problem should be solved but gives detailed instructions for making and checking the equipment.

The second prize goes to H. M. Bradley because he offers three stages of protection in his solution. First, he provides a means for automatically reducing the heating if it should be of a transient nature. Secondly, if the heating continues, he provides an alarm and thirdly, if no attention is paid to the alarm and the heating continues, the motor is automatically cut off. This triple protective feature, of course, was not required by the statement of the problem but it provides a much more complete solution.

Duplicate third prizes were awarded, one to Joseph E. Sullivant at Salina, Kansas, and the other to Thomas W. Benson of Philadelphia, Pa. The award to Mr. Sullivant was made on the basis of the extreme simplicity of his solution; he makes two suggestions, one using thermocouples and the other using simple thermostatic disks and an electric bell.

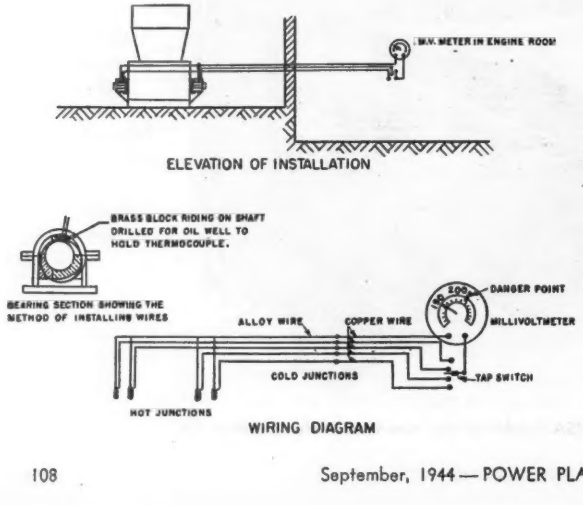


Fig. 1. (Left) Wiring diagram showing C. G. Clark's solution

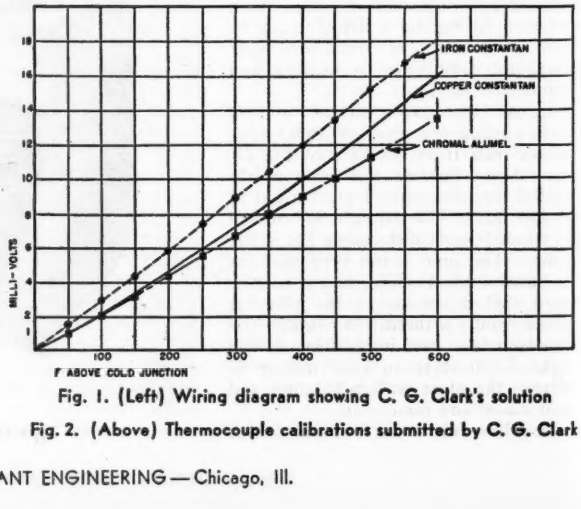


Fig. 2. (Above) Thermocouple calibrations submitted by C. G. Clark

Such thermostatic elements are easily available and are very effective. They provide the simplest and perhaps the most effective solution to the problem.

Mr. Benson's solution received recognition because of its homespun character. He also uses a thermostatic element but his is home-made.

FIRST PRIZE AWARD

C. G. Clark
Saint John, N.B.

The best solution for this problem depends to a large extent on the amount of money that is justified by partial or complete protection of the production capacity involved. It is assumed that the mill bearings are of good design, in good mechanical condition, and adequate for normal full mill load. The type of drive is not stated nor is it stated if the quality of product leaving the mill imposes any maximum or minimum restrictions in operation. The fineness of product usually determines the most desirable rate of output. If the mill product is hot and bearings are overheated from this source of heat it may be necessary to water cool bearing housing for satisfactory operation.

A wide variety of standard equipment is on the market which is readily adaptable to a problem of this type. Materials and equipment that can be used for temperature indications or control are as follows:

1. Special paints and crayons are available that indicate temperature limits by color change or smear. The application of these is limited by the necessity of some person being within sight of the mill bearings.

2. Thermometers of various types can be fitted with extra tubing to allow indicators or recorders to be located in the engine room.

3. Thermostats consisting of an enclosed vapor system with bulbs and bellows can be used to operate alarms at distant points at any desired temperature.

4. Fusible link such as used in fire protection equipment could be used with a mechanical or electrical system operated when link ruptures.

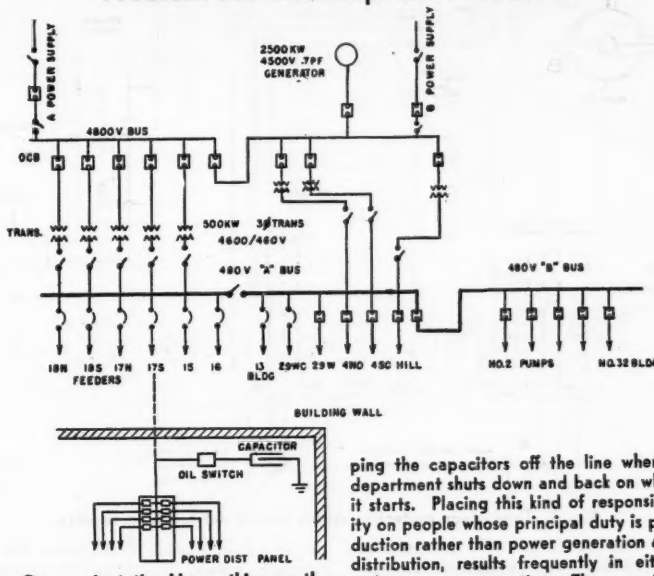
5. Multi-point thermocouple with millivoltmeter and tap switch located in the engine room.

6. Various types of pyrometers are available ranging from indicating to recording and controlling.

7. Several types of mill feeders are available which will vary mill feed to give constant power input or constant weight input. These can be fitted with elements to react from temperature rise of bearings. If present trouble is caused by erratic or excessive loading this type of feeder would improve operation as well as eliminating the bearing failures.

Equipment under items 3, 4, 6, and 7 could be designed to reduce mill input or shut down mill motor in addition to indicating or recording actual temperature.

Problem 36. The Capacitor Problem



Our peripatetic Hero, this month, seems to have stumbled upon a really worthwhile problem. While visiting a large manufacturing plant in the middle west he found the engineering department at that plant confronted by a rather annoying situation in connection with the operation of their capacitors.

Our Hero furnished us with a complete wiring diagram of the electrical system but this seemed unnecessarily complicated for the purpose of presenting the problem so the accompanying simplified diagram was drawn from this. As shown power is supplied by two outside lines as well as a 2500 kw generator. This 4800 v power is stepped down to 480 v and delivered to two 480 v distribution buses, "A" and "B". From these 480 v buses feeders distribute the power to the various buildings throughout the plant. These feeders are designated 18N, 18S, and so on. These designations refer to the building or locality served. 18N means 18 North. These feeders terminate at power distribution panels in the various buildings, as shown by the single example Feeder 17-S.

Just ahead of the panel at or near the terminal of each feeder there is a capacitor of sufficient capacity to provide full power factor correction under full load. These capacitors are cut in or out in their entirety by an oil switch.

Now this is where the trouble arises. In theory, the Operating Departments are charged with the responsibility of tripping the capacitors off the line when a department shuts down and back on when it starts. Placing this kind of responsibility on people whose principal duty is production rather than power generation and distribution, results frequently in either under or over correction. The operators either forget to switch the capacitors on when the department starts up or off when it shuts down.

The current investigations grew out of a desire to put this control of the capacitors into the hands of the power plant engineers. It was thought at first that some kind of "carrier current" relaying scheme might work but investigation proved that the costs of such a system would be to high for industrial use. So they are looking around for some other way to control the capacitor switches and they put the question up to Our Hero. There are a considerable number of capacitors and they are widely scattered over the property; pilot wires are rather out of the picture because of the expense.

Suppose this was your problem how do you think you would attack it?

Write out your opinion of this problem in a letter of not more than 1000 words, illustrated with diagrams if necessary, and send it to us. We will award a $25.00 War Bond for the best letter, and prizes of $10.00 and $5.00 respectively for the second and third best letters. The decisions of the judges in this contest will be final.

Entries for this contest should be mailed not later than September 30, and should be marked Problem 36. Address all letters to the Contest Editor, Technical Publishing Co., 53 West Jackson Blvd., Chicago 4, Ill.

From the problem statement it is assumed that Our Hero wants a reliable indicator at a relatively low cost that could be largely built and installed by present staff. Item 5 is suggested as being the most suitable. By using a multipoint switch any number of thermocouples may be used at different bearing points. No operating expense is required for batteries or other materials. The materials to be purchased are a high resistance millivoltmeter, a tap switch, and some wire with suitable insulators. An engine room attendant can take readings of all points at hourly or whatever intervals are required and any one point can give a continuous indication. By making it routine procedure to log temperatures the mill operating condition is constantly emphasized which is not the case with automatic alarms or controls. The thermocouple cold junctions can be grouped and located at any point which is reasonably constant in temperature. The millivolt-

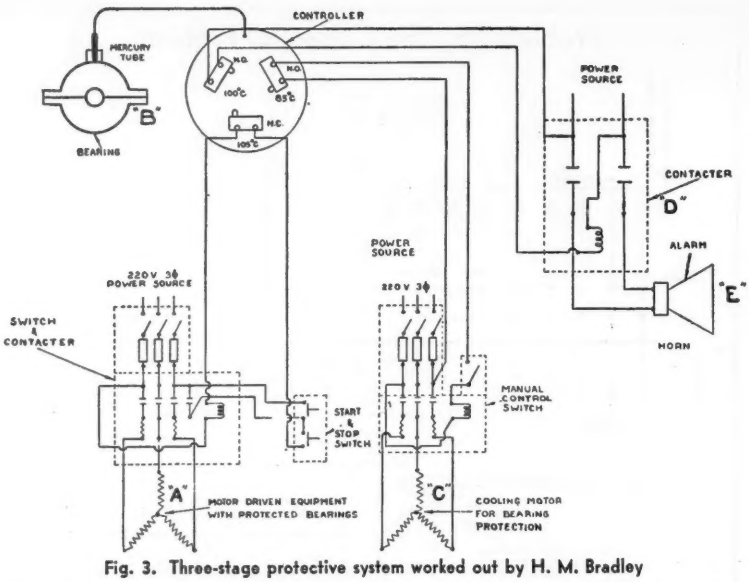


Fig. 3. Three-stage protective system worked out by H. M. Bradley

meter can be fitted with an auxiliary scale reading degrees above cold junction with a prominent mark at the point where remedial action is necessary.

The thermocouples can be of various materials depending on the temperature range and the maximum temperature reached by the bearings. Calibration curves for three metal combinations are shown on the accompanying graph, Fig. 2. Hot junctions should be welded by fusion without other metal rods. Cold junctions will be at point of joining copper and alloy wires. With a multi-point installation one wire, usually the positive, is common to all thermocouple leads.

The couples can be easily checked at 212 F by direct immersion of hot junctions in an open pot of boiling water. At lower temperatures comparison with a mercury thermometer in cooler water or in hot oil at higher temperatures gives a ready field calibration method. The ease of checking the calibration makes this a simple system to maintain in a reliable operating condition. The millivoltmeter should be selected with as low a scale range as possible for the temperature required as shown by the graph. Because of the low voltages involved it is necessary that all contact losses be minimized by welding or soldering.

The installation is illustrated by the accompanying sketch, Fig. 1.

SECOND PRIZE AWARD

H. M. Bradley
Stratford, Conn.

In order to protect the bearings on this type of equipment three factors should be considered.

1. A method of cooling down the bearings when excessive heat occurs. In this case this will be done with the conventional industrial type cooling fan placed in such a position that it has a direct effect on the bearing itself. 2. If bearing continues to heat up beyond cooling capacity of fan, a warning device would go into operation to notify operator of dangerous condition existing. 3. If warning signal is ignored, and bearing temperature increases, provision should be made to stop equipment before damage is done.

There are standard controllers on the market at various temperature ratings that would be applicable to any particular design of bearing. However, the sketch shown in Fig. 3 is submitted and wiring installations can be made by the plant electrician without too much expense.

SEQUENCE OF THREE STAGE PROTECTION

1. When motor (A) is operating equipment connecting to bearings and if the temperature reaches (85 C) controller causes switch to close marked (85 C), which in turn starts bearing cooling fan motor (C). If the bearing temperature continues to rise and reaches a (100 C) switch marked (100 C) on controller closes, operating relay (D), which in turn sounds alarm horn (E). Last, if temperature reaches (105 C) switch on controllers marked (105 C) will open the remote control circuit of motor (A) stopping equipment and protecting the bearing before an excessive temperature rise would spoil the equipment.

THIRD PRIZE AWARD

Joseph E. Sullivant
Electrical Engineer
For The Post Engineer
Smoky Hill Army Air Field
Salina, Kansas

The bearings will run hot. Let's assume there is nothing that can be done except decrease the load before the temperature reaches a danger zone. The practical method used to measure temperature of this nature is with a temperature meter, or temperature indicator, thermocouple type. A detector coil must be used with the temperature meter. Most of these operate on 115 v 60 cycle, however, these detector coils are built into a machine and are most generally used to measure temperaeture of a-c machinery, such as alternators, etc., so we cannot apply this method.

A temperature indicator thermocouple type requires the use of thermocouples. We may use this means of indicating temperature if the distance from the thermocouple to the temperature indicator is not too great. The resistance of the thermocouple will depend upon the distance at which the temperature indicator is located, as the thermal lag will have to be compensated for. Figure 4 shows the schematic connecting diagram.

These instruments can be obtained from anyone of the several noted manufacturers namely, Minneapolis-Honeywell Regulator Co. and The General Electric Co.

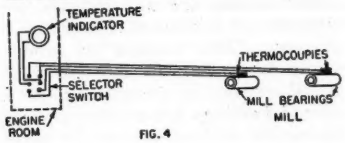


FIG. 4

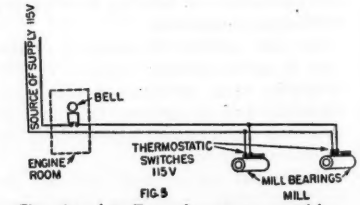


FIG. 5

Figs. 4 and 5. Two schemes proposed by Joseph E. Sullivant

A second method consists of thermostats connected in parallel to a bell circuit. This method can be installed at a very small cost and I believe will produce the desired results. The thermostat should be made securely fast to the bearing itself so as to get proper conduction of heat. Figure 5 shows schematic connecting diagram.

It seems rather peculiar to me that Our Hero wishes to have an alarm system installed to tell him that trouble is close at hand unless the temperature rise of the bearings is checked or decreased by lowering speed, load or drive tension. Instead of an alarm system, if I were responsible for the operation of this mill it seems that the correct procedure would be to eliminate the cause of these bearings to heat.

DUPLICATE THIRD PRIZE

Thomas W. Benson
Philadelphia, Pa.

The remote indication of temperature changes can be accomplished by utilizing any one of the many physical and electrical effects of heat. Thus we have available for the purpose at the transmitting point located on the apparatus subject to change of temperature, devices that may employ the expansion of mercury or other volatile liquids, distortion of bimetal bars, thermocouples, change of resistance of metal conductors, merely mention a few.

There are a number of methods of transmission, electrical, hydraulic, pneumatic and mechanical, of which the electrical is simplest to install and most dependable particularly when the circuits are so arranged as to give continual check on continuity of the circuits.

And finally at the indicating end there may be employed audible or visual signals actuated directly from the transmitted currents or through relays or meter movements.

My choice of an alarm circuit for heating bearings would employ a bimetal strip at the transmitting end actuating a sealed contact mercury switch. The switches to be arranged so as to be closed at normal temperatures and opening when the bimetal strip is subjected to an increase in temperature. With such a closed circuit system it is possible to employ a lamp at the indicating point that is normally lighted and thus check on the circuit continually. The circuit I would employ is a bit unique in that it can be arranged to cause the indicating lamp to blink as a warning or an audible signal can be employed without using relays.

The apparatus and circuit are shown in Fig. 6. The heat actuated switch can be mounted in a 2 by 4 in. utility wiring box and consists as shown of a Mercoid or similar switch riveted to a bimetal strip bent into a loop. A strip of this metal ½ in. wide and 2½ in. long of 1/16th stock can be formed into the shape shown, the switch clip mounted and then riveted to the metal box.

Should it be difficult or impossible to obtain the bimetal stock the loop may be made up without much trouble. Wrap a strip of 1/32nd brass, ½ in.

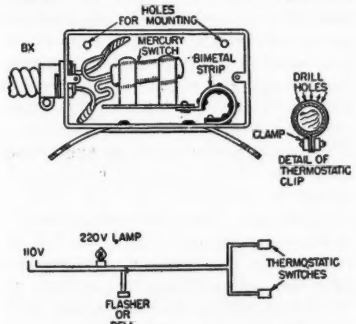


Fig. 6. Thomas Benson's home made thermostatic switch

wide and 2 in. long around a 5/8 in. wood dowel. A strip of sheet iron of the same thickness and width but an inch longer is wrapped on top with the ends clamped as shown in the detail drawing. Two rows of small holes may then be drilled through the two strips and the two strips riveted together with small rivets.

The switch mechanism may be mounted on the cap of the bearing to be protected by means of the strap fastened to the bottom of the box or the box mounted on the lower part of the bearing by screws through holes in the back of the box. Connections may be made with BX to the switch element and the latter clipped into position. After mounting, the switch can be set by making temporary connections to the lead in the BX with a lamp in series and then bending the bimetal strip slightly until the lamp stays lit but goes out when the end of the switch clip is raised ¼ in.

The wiring diagram shows the two switches, one on each bearing connected in series with a lamp to the 110 v lighting circuit. A 220 v carbon light will give an indefinite life if used as the indicating lamp. For a visual signal a thermostatic flasher is connected across the leads to the switches as shown. Normally the light is on but should one of the bearings heat the loop will tilt up the mercury switch and open the circuit. Current will then flow through the flasher and cause the lamp to blink on and off, a much better arrangement than to simply depend on the lamp going out as an indication.

Should an audible signal be desired it is only necessary to connect a heavy duty bell in place of the flasher. Normally the bell is shorted out by the closed thermostatic switches but a hot bearing opening the circuit will allow current to flow through the bell.

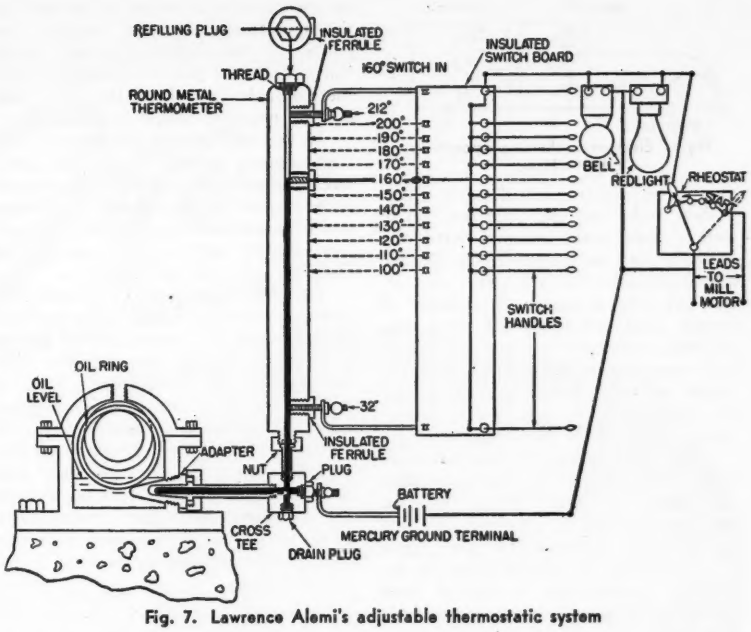


Fig. 7. Lawrence Alemi's adjustable thermostatic system

General Comment

Although most of the solutions could be classified according to a relatively small number of groups, individually they varied considerably in their method of treatment. Some, as already pointed out, made use of ingenious home-made arrangements. Some were quite lengthy in their analysis; others short and laconic. On the laconic side, for example was the letter submitted by Aime J. Orban, Engineer of the Springfield Cold Storage Co. at Springfield, Mass. "All Our Hero needs for his problem," writes Mr. Orban, "is two dry cells, one door bell, and a thermostat. Set temperature to what he thinks is alarmingly hot. Clamp gas bulb of thermostat in bearing box, file small groove in bearing cover so as to fit gas tubing coming out of bearing. He must place gas bulb so it won't interfere with oil chain or ring. Place thermostat on wall or stand next to bearing, then wire up batteries and bell in engine room or boiler room where there is a man that has sense enough to grab an oil can and run to the bearing as fast as possible if the bell rings. Any engineer can make it work so that it is fool proof." Well, that's all there is to it—just plain common sense, isn't it?

A. R. Markland, in analyzing the problem, felt that any warning device Our Hero might make should operate when the oil leaving the bearing lining reaches an excessive temperature without waiting for the heat to be transmitted to the bearing housing. He points out that steam turbine bearings have frequently been found to have considerable babbitt pulled from the bottom half of the bearing without any external evidence of overheating at any time. Mr. Markland suggested the use of an expansion bulb type of thermostat.

One of the most elaborate home-made devices suggested was that embodied in the solution of Lawrence G. Alemi of Camden, N. J. This is shown in Fig. 7. It consists, essentially, of a mercury column connected to a bulb in the oil reservoir of the bearing. The column is arranged with a

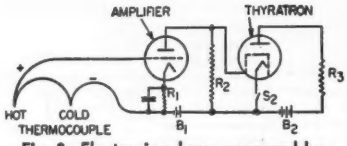


Fig. 8. Electronic scheme proposed by H. H. Nord

number of insulated ferrules into which switch rods can be inserted. The switch rods make contact with the mercury and so complete an electric circuit consisting of a battery, an electric bell and a lamp. A number of switch rods are provided each one of which corresponds to a certain limiting temperature depending upon the height at which it makes contact with the mercury. The principle of operation is clear from the diagram.

The construction of this arrangement would involve considerable time and effort but there is no question but that it would be effective. To one mechanically inclined and with some time available, it would form an interesting project but in view of some of the more simple systems available and which are entirely adequate, it is doubtful whether Our Hero would care to use Mr. Alemi's arrangement. The system has the advantage of being entirely home-made and in case one had difficulty in purchasing commercial equipment, this system might prove a way out. It shows considerable ingenuity and provides both visual and aural warning and automatic protection. As shown on the diagram, when the bearing reaches a temperature of 180 deg the bell rings, the red light brightens at the engineer's desk and the rheostat kicks out or the speed of the mill is automatically reduced by a stop affair on the rheostat.

Although electronic devices are not strictly necessary in the solution of the problem it is interesting to note that several of the contestants suggested electronic methods. One of these was H. H. Nord of Chicago. Writes Mr. Nord, "I am a June graduate in Mechanical Engineering, having also had a course in industrial electronics. When I saw your Problem 35 in the July issue of the POWER PLANT ENGINEERING magazine, I was very much intrigued to apply what little I know about electronics to your problem.

Figure 8 is a rough circuit diagram of what I have cooked up.

At the left-most portion of the diagram is a thermocouple, of which the cold junction may be immersed in ice, and the hot junction is applied to the bearing. When there is a temperature difference between the two junctions, there will be a potential difference between the terminals of the thermocouple, which varies almost directly with the temperature difference.

The terminal from the cold junction is negative and is connected to the cathode terminal of the amplifier, which is shown to the right of the thermocouple. The positive terminal of the thermocouple is connected to the grid of the amplifier. Since the negative potential of the cathode is very large compared to the positive potential of the thermocouple, therefore the grid bias will be negative, which is desirable.

If the temperature difference of the thermocouple becomes large, the positive terminal will become more positive with respect to the negative terminal, which means that the grid bias becomes less negative, and a larger current will flow through the amplifier.

By Ohm's Law, with a constant resistance, the voltage varies as the current. Therefore, if the current driven by the B_1 battery through the amplifier and the resistance R_2 is sufficiently large, it will create a certain definite positive potential across the resistance (or at the grid), which will break down the thyratron shown at the right hand side of the diagram. The current through the thyratron will flow continuously until the switch S_2 is opened. This current can be utilized by making it operate an electric bell or other alarm device, shown here only by the resistance R_3.

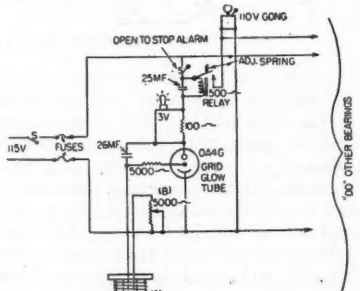


Fig. 9. Freeman-Eidam grid glow tube system

As far as practicability of this device is concerned, it can be said that the maximum fluctuation of the thermocouple is only a few millivolts, however, this will create an appreciable fluctuation of current through the amplifier. The resistance R_2 can then be adjusted so that the thyratron *will* break down at the point where the temperature difference warrants an alarm. This will be a very fine adjustment, but since there are no mechanical devices, there is little chance for losing adjustment.

The cost of building and operating this gadget should not be too high. Besides the other very common elements, there is only the amplifier and the very small scale thyratron both of which are standard electron tubes. The operating costs include only a continuous small current from the B_1 battery and a current from the B_2 battery whenever necessary.

A. J. Freeman and E. L. Eidam of El Portal, Cal. used a different way of solving the problem by the use of electronics. As shown by Fig. 9, they use a grid glow tube. Quoting from their letter, "The means by which the alarm system is actuated is through the flow of current through the OA4G grid glow tube. The value of this current is a function of the resistance coil in the oil well. As the temperature of the oil increases, the current will diminish. The resistance (b) is for close adjustment and can be set so the relay will operate at any desired temperature of the bearing. The small 3-v lamp will act as a pilot to tell which bearing is hot in case there are several bearings connected to the system. Only one gong will ring but one of several lamps will indicate which bearing is running hot." This system is entirely practical and has the advantage that thermocouples are not required. Only one tube is needed and that is a small tube commonly used in radio work.

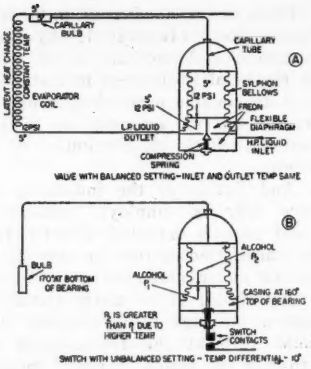


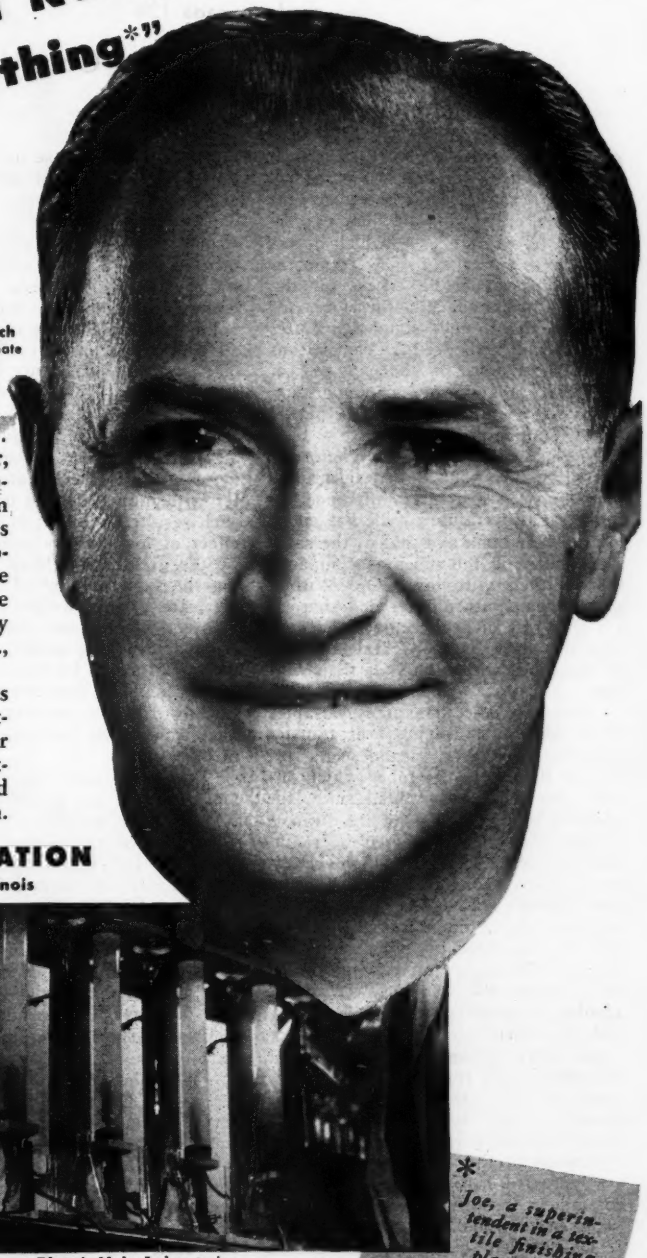
Fig. 10. Diagrams showing reconstruction of thermoexpansion valve suggested by Hollis Wyman

One of the most interesting things in the solution of many of these problems is the ingenuity displayed by contestants in devising home made parts. In this instance Hollis G. Wyman of Auburndale, Mass., for example, showed how he would reconstruct a thermoexpansion valve of the type used in refrigeration to suit the needs of this problem. The ordinary thermoexpansion valve used in refrigeration systems usually operates on a lower scale of temperature than that involved in the bearings. As shown by Fig. 10 (A) and (B) he removes the Freon normally contained in the valve and substitutes alcohol. He removes the high and low pressure liquid inlet and outlet fittings and replaces the valve seat with a packed bushing to allow the former valve spindle to protrude through the bottom of the casing. On the end of this spindle he places a contact point for the electrical alarm circuit.

In closing it is only fair to state that the solutions referred to above constitute only a small proportion of the many submitted in this contest. Many others deserve comment because of their fine approach to the problem or because of ingenious arrangements developed, but space is limited and we can only express our gratefulness to those who sent in solutions which cannot be mentioned here.

"But Joe..."

we never said Nalco was good for everything*"



J. H. Gronbach
National Aluminate Corporation

WE are right with you on that subject, Joe . . . we would not have anything in our plant either, *that does everything!* We have dug into the subject of boiler feed water treatment too far to claim that there is any one-shot, cure for *all* the ills caused by untreated water. But our modern laboratories have discovered and established definite facts regarding water treatment . . . facts that are enabling power plant engineers to successfully prevent scale, corrosion, foaming, algae, etc., under a wide range of conditions.

Nalco's modern water treatment laboratories have revolutionized certain phases of water treatment to bring to Nalco customers fewer boiler outages, more boiler capacity and lower operating costs. Ask for a Nalco survey today Joe, and you will see what we mean. There's no obligation.

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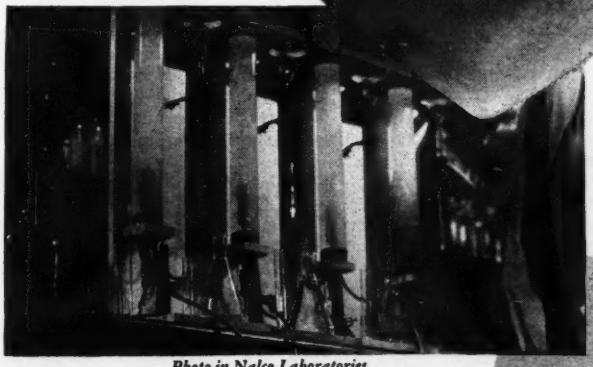


Photo in Nalco Laboratories

* *Joe, a superintendent in a textile finishing plant says—"I wouldn't waste my time on water treatment that does everything."* Source: Survey conducted by a well-known power publication.

Nalco ...The Complete Water Treating Service

Boiler Fireman's Handbook

By J. R. DARNELL

Heat transfer from flame or fuel bed to tubes . . . Transfer by radiation . . . The Stefan-Boltzmann Law . . . Effect of increasing temperatures; of decreasing temperatures . . . Curves showing effect of increasing excess air and reducing CO_2 . . . Flue gas temperature is lower with higher furnace temperature . . .
See chart on page 124

II—Why Flue Gas Temperature Goes Up When The CO_2 Goes Down

OBSERVANT BOILER firemen sometimes wonder why the flue gas temperature increases when the percentage of CO_2 in the flue gas decreases. With high CO_2, which means low excess air, the furnace temperature increases as the excess air decreases. It is difficult, therefore, for some firemen to understand that hotter gas entering the boiler tube bank means lower temperature of the exit gas, or conversely, that for the same capacity, lower inlet temperature means higher outlet temperature. In the case of high CO_2, since the gas is hotter before it enters the tube bank, it is evident that there must be a greater difference between the temperature of the gas entering the tube bank and that of the saturated steam in the tubes as compared to conditions with low CO_2. With a greater temperature difference, there is a higher rate of heat transfer and consequently there is more heat absorbed by the tubes with high CO_2 than with low.

There are, of course, many variables to consider in explaining heat transfer from furnace gases, incandescent fuel bed, or flames, to the tubes which absorb the heat. However, since the greatest source of heat in the furnace is that which is transferred by radiation, a simple explanation of the conditions which causes a greater rate of heat transfer with higher CO_2 and its resultant higher temperature, is the fact that heat transfer by radiation is approximately proportional to the difference between the fourth power of the absolute temperature of the furnace gas and the fourth power of the absolute temperature of the outside surface of the tubes which receive the heat. This phase of heat transfer by radiation is known as the Stefan-Boltzmann law. Space does not permit a comprehensive discussion of this law, but those who are interested may find a detailed discussion in various engineering handbooks or text books on combustion.

Calculations based on the Stefan law show that increasing the furnace temperature from 2000 to 3000 F will increase the amount of heat absorbed by radiation by almost 400 per cent. As the temperature goes down, however, the decrease in heat absorption is at lesser and lesser rates. For example, if the furnace temperature is reduced from 2500 to 2400 F, the amount of heat absorbed by radiation decreases only about 12 per cent. Heat absorption, however, is cumulative in either case, since the volume of furnace gas must pass over an appreciable amount of heating surface before the difference between high CO_2 and low CO_2 is observable by readings of flue gas temperature. In the average boiler, the gas must make at least two passes through the tubes before the effect of greater heat transfer with high CO_2 will begin to show such results. While it is true that the effect of low CO_2 is somewhat offset by the greater weight of gas (assuming the same amount of fuel burned), since the greater weight of gas means greater velocity and thus causes increased scrubbing action, this increase in heat transfer by convection in the case of low CO_2 does not begin to compensate for the greater increase in heat transfer by radiation in the case of high CO_2.

In a great many water tube boilers, after the gas has passed through the tube bank for a distance of 14 to 16 ft, the effect of the higher temperature with high CO_2 and resultant increased heat transfer, becomes evident. In the chart on page 124, curve A shows temperatures through the tubes for an actual furnace temperature of 2700 F. This corresponds to 13 per cent CO_2 (42 per cent excess air) when burning representative Eastern bituminous coal. Curve B shows temperatures when burning the same quality and quantity of coal with 84 per cent excess air (10 per cent CO_2). This gives an actual furnace temperature of 2200 F. The temperature gradient is steeper with A than with B, and after the gas has traveled for about 14 ft the curves cross each other. The temperature of the flue gas, after the gas has passed the last tube, is 540 deg for A and 610 deg for B.

It should be noted that the point where the curves cross depends on a number of variable conditions, depending not only on the quality of the coal and the mean specific heat of the various constituents of the products of combustion, but on the heat absorbing characteristics of the boiler tubes. But regardless of the range of temperatures, the curves will always cross somewhere between the first and last tubes.

For any given CO_2 value with any given fuel, there is a definite and direct relationship between that CO_2 percentage and the actual furnace temperature. As the CO_2 decreases, the furnace temperature also decreases. This relationship for various representative fuels will be discussed in a subsequent chapter.

Fuse Man Still Growing

(*Continued from page* 101)

The "Fused Man" or "Fused American" as Mr. Hawkins now calls him is 7 ft tall, a yard wide and a foot deep. He has fused eyes, fused ears, a fused nose and smokes a fused cigar. He sports fused finger rings and has a pair of fused feet.

Since we last displayed him in these pages several years ago, a number of fuses have been added to the collection and the Fused Man has now become so top heavy that he will have to be overhauled before he can be exhibited again. These alterations are now in progress so if any of those reading this account have old, interesting fuses around which might add to the interest of this collection, Mr. Hawkins will appreciate having them sent to him at 111 Ridgewood Ave., Brooklyn, N. Y.

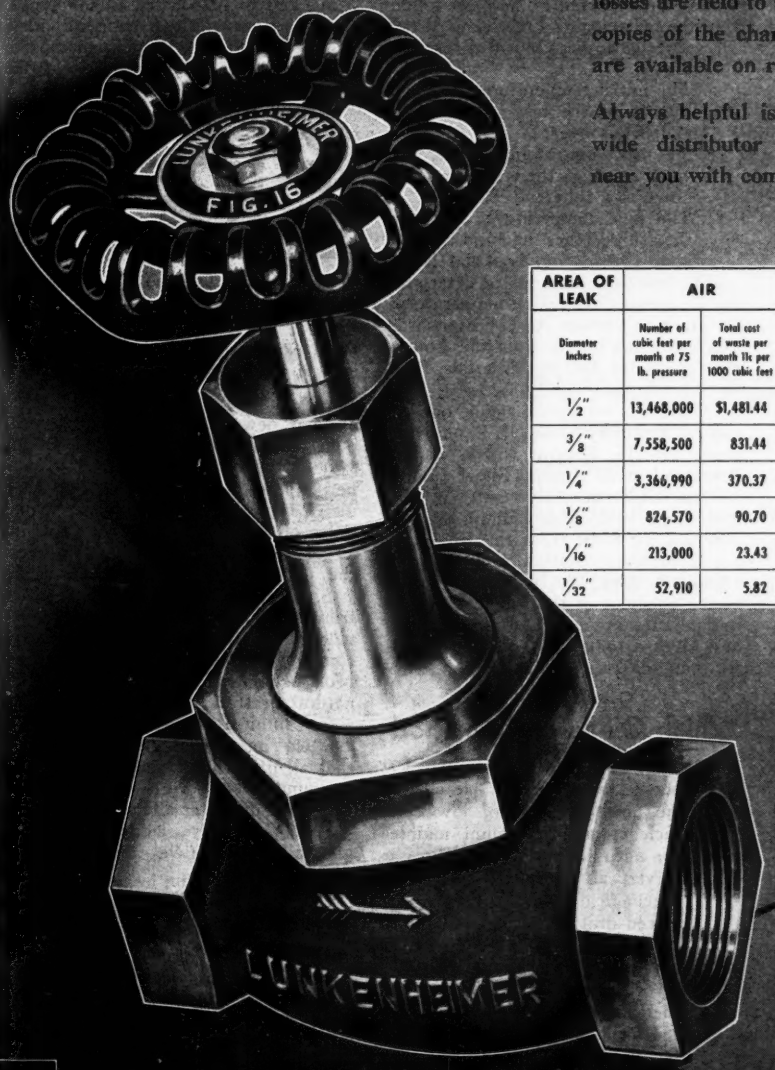
In the collection are old link fuses, plug fuses, cartridge fuses, colored glass top jewel fuses, a wooden fuse and wooden cleats from New Mexico used in the days when electricians made their own fuses. There are fuses that were once used in lighting old schools, churches, hospitals, theaters, old police and fire houses, fairs and circus grounds, railroad stations, docks, piers, ferry houses, colleges, caverns, mines, car barns, etc. There are fuses in the collection that were used in lighting the Statue of Liberty torch, the Capitol at Washington, The New York World's Fair Trylon, the Tower of the Sun at the San Francisco Fair, fuses from the Sandy Hook Lighthouse, Carlsbad Caverns in New Mexico and many others from various sections of the country including fuses used on U. S. "Battlewagons." Mr. Hawkins just finished a 6 months' job of doing electrical maintenance work in a hospital built in 1872 and there he found four old plug fuses that are enclosed in china jackets and that date back to the gay nineties Mr. Hawkins closes his letter to us as follows: "if any readers have any old electric fuses laying around in the junk pile that you would like to add to the "Fuse American" collection, just mail it to me and I will add it together with a label telling where it came from."

You'll Save with LUNKENHEIMER VALVES

Economy in performance is the first essential of Lunkenheimer valve design . . . every detail is thought out and coordinated to insure tightness and long life with lowest possible outlay of time, labor and money for maintenance.

Glance at the chart immediately following. These startling figures show what leaky valves can waste . . . and conversely what good tight valves can save. Where Lunkenheimer valves are on the job and given ordinary care, these losses are held to a bare minimum. (Enlarged copies of the chart for posting in your plant are available on request.)

Always helpful is the Lunkenheimer nation-wide distributor organization. There's one near you with complete facilities to serve you.



AREA OF LEAK	AIR		STEAM		WATER	
Diameter Inches	Number of cubic feet per month at 75 lb. pressure	Total cost of waste per month 11c per 1000 cubic feet	Pounds wasted per month at 160 lb. pressure	Total cost of waste per month 65c per 1000 lb.	Gallons wasted per month at 60 lb. pressure	Total cost of waste per month 16c per 1000 gallons
1/2"	13,468,000	$1,481.44	1,219,280	$792.53	1,524,100	$243.86
3/8"	7,558,500	831.44	684,290	444.79	855,360	136.86
1/4"	3,366,990	370.37	304,820	198.13	381,020	60.96
1/8"	824,570	90.70	74,650	48.52	93,310	14.93
1/16"	213,000	23.43	19,280	12.53	24,110	3.80
1/32"	52,910	5.82	4,790	3.11	5,990	.96

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Questions And Answers

Question No. 269

Is Engine Compression a Saving or a Loss?

DURING A RECENT examination, a State boiler inspector propounded the following problem:

Prove in dollars and cents that compression in a reciprocating engine is a saving or a loss.

I'd appreciate the views of Q & A readers on this.

Holyoke, Mass. J. M.

Editor's Note—The question does not specify reciprocating steam *engine but it is reasonable to assume that is what he meant.*

Question No. 270

Terms Used in Coal Preparation?

IN GOING OVER some coal data, I found some terms that puzzled me, for I cannot find them discussed in the textbooks I have at hand.

1. What is the difference between ball mill and Hardgrove grindability?

2. What is the difference between fusion temperature of ash and fluid temperature of ash?

Buffalo, N. Y. W. M. H.

1.—In the ball-mill method, the relative amounts of energy necessary to grind coals to the same fineness are determined by the number of revolutions of the mill required to reduce 80 per cent of the feed (500 grams of 10 to 200-mesh coal) fine enough to pass a 200-mesh sieve. This is somewhat finer than the size ordinarily used for pulverized-coal firing.

In the Hardgrove machine method, 50 grams of coal, sized between 14 and 28-mesh (Tyler) sieves is ground in a special ring-and-ball machine for 60 revolutions. The resulting product, in which the amount of new surface is estimated from a screen analysis, is considerably coarser than pulverized fuel.

In short, as we understand it, in the ball mill method the relative amount of work required to grind coals to pulverized-fuel size is determined, while in the Hardgrove and other methods, an equal amount of work is performed on each sample and the relative grindability obtained by estimating the new surface produced.

You will find rather complete discussion of these two methods and comparisons of the results in a paper given before the AIM&ME in 1936 by Messrs. Yancey and Geer, abstracted in the March, 1936, issue of "Combustion." R. M. Hardgrove in Trans. ASME FSP-54-5, 1932, gave much of the original data on his work in this field. A section in Kent's "Mechanical Engineers' Handbook," 11th edition, pages 4-34 to 4-36, discusses grindability of various coals.

2.—Concerning fusion temperature of ash, three temperatures in the fusion process are important. These are found from the behavior of a test cone of the ash, subjected to heat in a test furnace. They are:

a. The initial temperature, at which the tip of the test cone softens and bends over;
b. The softening temperature, the value at which the test cone fuses down to a spherical lump;
c. The fluid temperature, at which the ash becomes fluid and the test cone spreads out in a flat layer.

The standard methods of determining the various ash fusion temperatures are given in various ASTM Standards which you can obtain from the American Society for Testing Materials, Philadelphia, Penna.

There is a very good article on Ash and Its Fusibility by W. D. Langtry on pages 107-115, Reprint No. 7, Papers Presented at 2d Annual Short Course in Coal Utilization, University of Illinois, June, 1935. This bulletin may be obtained for $1.00 from the Engineering Experiment Station, University of Illinois, Urbana, Ill. It shows a picture of the behavior of the ash test cone at initial, softening and fluid temperatures and gives a long table of their values for many different coals.

Question No. 271

Which Oil-Burning Method Should He Use?

WHICH is the more desirable method from the point of view of low cost, best efficiency and minimum maintenance for burning Bunker C oil in our Manning vertical fire tube boilers?

1. Mechanical atomization with forced draft, and oil under pressure, or
2. Steam atomization without forced draft. In this case the fuel may be fired either from the firing door or from the center of the furnace

These boilers, now hand fired with coal on 96-in. grates have approximately 300 cu ft of combustion space each and are rated at 310 bhp each.

Chicago, Ill. J. L. W.

Answer No. 248

How Can Boiler Operation Be Improved?

SUPPLEMENTING my analysis in the April issue of J. S. R.'s problem of uneven burning in the fuel bed of a chain grate stoker, I cannot agree with the statement in the May issue by Arthur J. Stock that coal segregation is to blame. Assuming the bare possibility that the coal does have the uneven distribution shown by Mr. Stock's Fig. 1, it is extremely doubtful that this alone would cause the uneven burning to the extent mentioned by J. S. R.

Furthermore, the operation of a screw conveyor, *per se*, does not cause the type of segregation shown by Mr. Stock. Opposing screws usually work the coal from the center of the hopper to the sides. If the coal is of uneven sizing and is avalanched to the center of the hopper, the conveyor will have a tendency to work the large lumps to both sides of the hopper while the fines will remain in the middle.

Troubles with air distribution as well as those with coal segregation

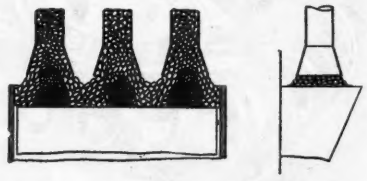

Fig. 1. Round spouts discharging above the level of the fuel hopper caused this uneven distribution of coal particles.

are not new. Each, however, has its own characteristic symptoms. In my own experience, extending over a number of years, I have never seen a screw distributor which placed the large particles on *one side* only. In cases such as assumed by Mr. Stock, but not the particular condition described by J. S. R., even if there is no screw distributor and care is not taken to provide for even sizing and distribution, combustion troubles are likely to occur. Most chain grate stokers, whether natural draft or forced draft, are designed to burn what is generally known as "1¼ in. screenings". This means that all of the fuel must pass through a round-mesh screen with openings 1¼ in. in diameter. The largest lumps will be of this size, while most of it is generally of particles no larger than ½ in. diameter.

Care must, therefore, be taken in the method in which the fuel is fed

Fig. 2. Spouts with flattened ends discharging below level of fuel hopper provided even distribution.

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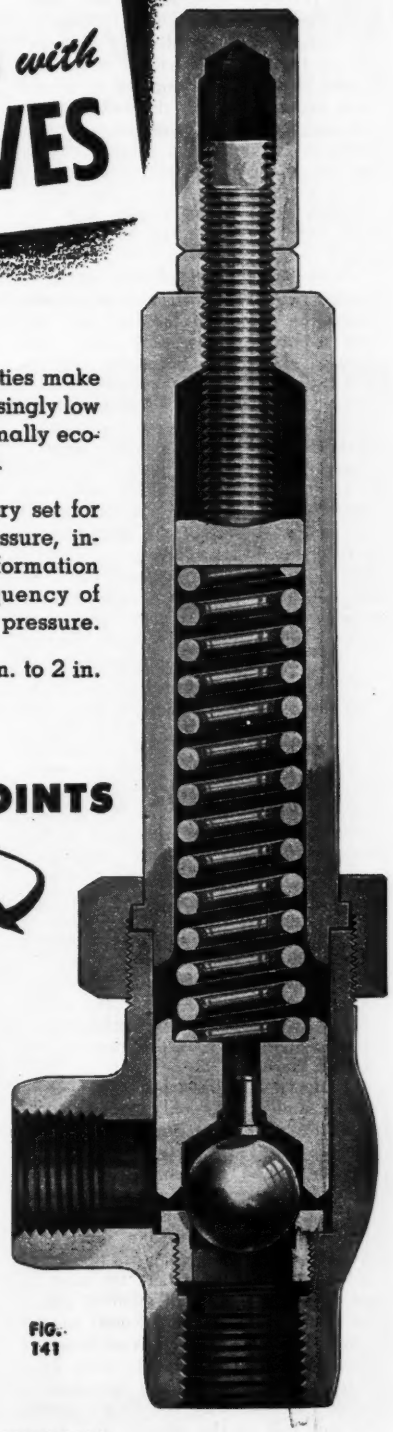

FIG. 141

Look for These IMPORTANT POINTS

BODY
Drop forged heat treated steel. Distribution of metal around body flow areas equalized so that in heating and cooling there is negligible distortion.

BONNET
Rolled carbon steel, with body and locknut joints carefully ground for tight fit.

BEARING PLUG
Hardened stainless steel. Point contact always permits disk to reseat promptly and tightly.

BALL DISK
Hardened corrosion resistant stainless steel, accurately ground for tight seating.

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Fine carbon or stainless steel spring, adequate length for full area when discharging. Design of adjusting mechanism makes possible close pressure regulation.

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to the stoker hopper. If it is allowed to avalanche out of a round spout or spouts suspended above the hopper, there is great danger that, as the fuel slides through the spouts, it will separate, the larger lumps being thrown to the outside, so that distinct segregation of fuel particles will be noticeable in the fuel bed. A number of plants have experienced this difficulty, which not only affected combustion conditions but gave rise to other troubles. In one of the plants which I have in mind, the fuel was fed to the hopper through three round spouts with the ends flared in bell-shape as shown in Fig. 1.

This segregation of fuel particles caused two distinct streaks or grooves down the center of the fuel bed and also a streak along each side. The streaks or strips along the side in which the fuel was burned down nearer to the grate were not so noticeable as those in the center, since combustion in the fuel bed is usually more complete along the sides than in the center. This is due to greater air leakage and more rapid burning. The grooves in the fuel bed on either side of the center spout were distinctly noticeable but operators did not realize what was causing them nor did they connect the cause of these grooves with another and even more serious difficulty—that of arch erosion.

Air naturally follows the lines of least resistance and will accordingly pass through the fuel bed along points where the fuel particles are coarsest. This obviously causes a greater evolution of gas along the strips of coarse fuel. So much gas is generated above these narrow strips that complete combustion of much of this gas is not effected until it strikes the arch. This causes higher temperatures just above the strips of coarse fuel than at other points, with a resulting softening of the arch. With these longitudinal strips of the arch softened by the high temperature and a greater density of gas along these lines it is quite easy to see what would cause distinct grooving or erosion of the arch as the gases sweep around the end.

Remedy for this trouble was quite simple and it was only necessary to alter the method of supplying fuel to the hopper. This was done by removing the round, bell-shaped flares on the ends of the spouts and substituting sections which were flattened out as shown in Fig. 2, allowing more fine particles to be dropped across the width of the stoker. In addition, the sides of the fuel hopper were extended above the old level, so that the ends of the spouts would be covered at all times, if the hopper and the spouts were kept filled all the way up to the bunker above. In this way the larger lumps did not roll to the outside and there was no distinct segregation.

After the fuel spouts were changed, a marked improvement was noted all around. There was less carbon in the ash, a better quality of furnace gas, and no appreciable erosion of the arch.

Naperville, Ill. J. R. DARNELL

Answer No. 250

How Stop Fuel Waste in This Unit Heater System?

Another heating season is approaching and to make it worse, we've got to save 29,000,000 tons or so of coal this year. So if you have unit heaters, look back over the answers to this question published in each issue from March to July and take such tips as you can use. You'll find some good ones there.

In addition, here is a summary of just a few of the replies we have not space to publish. Leo R. Schulte of Detroit amplifies his April comment with the caution to turn unit heater steam valve on very slowly, preferably with a warm-up by-pass, otherwise the traps will blow through and raise the back pressure.

A flash tank for the returns seems the correct solution to Thos. W. Benson, Philadelphia, Pa. Also, he believes the steam pressure to these heaters should be reduced to about 40 psi, perhaps necessitating a few changes in trap valve mechanism, if the manufacturer recommended it. J. R. Darnell, Naperville, Ill., also maintains that this system should be operated on low-pressure steam at 5 psi through reducing valves and thus get higher heat recovery from the higher latent heat of vaporization of the low-pressure steam, one of the reasons why exhaust steam is often used for heating. William Youmans of Fithian, Ill., agrees that the system should be on low-pressure, say 5 psi, looking well to the traps. Bro. John Joseph Geisen of St. Joseph's College, Weltmont, Ill., doesn't see why the vacuum is needed with high-pressure steam. D. M. Keas, Leavenworth, Kans., says low-pressure ought to heat this system if the heater capacity is anywhere near right.

Answer No. 260

How Prevent Spontaneous Combustion of Coal in Silos and Bins?

BECAUSE no other storage space was available, said E. H. R. in the May issue, he wanted to store reserve coal in a 24-ft inside diameter coal silo. He wanted to know the best method of preventing spontaneous combustion in this coal and of putting out a fire if it did start. W. N. S. wanted to know the same thing about coal stored in an underground bin 50 ft long, 50 ft wide and 16 ft high, which he planned to enlarge to 100 ft long. He said he had had fires in coal that had been stored for several months in this bin.

Both Should Observe Fundamental Storage Rules

BOTH E. H. R. and W. N. S. should observe certain fundamental rules for the storing of coal. They are:

1. Prevent air circulating through the coal;
2. Select a coal with low moisture and low sulphur content;
3. Select a clean coal or remove foreign matter from coal before storing;
4. Store sized coal ¾ in. or larger;
5. Avoid all sources of external heat.

E. H. R. in particular must take pains to prevent air flow through his coal. A relatively large amount of air can flow into the coal through small cracks and slits or poorly closing gates. Some air usually flows up the chute even when it is full of coal. Often air leaks in a silo can be detected by use of a lighted candle.

Capping stored coal will prevent air circulation and will even put out fires down in the pile. Coverings that have been used include fine coal dust, cut-back asphalt, asphalt emulsions, and road tar. These also prevent coal dust nuisance and moisture penetration. Asphalt emulsions having 40 per cent water and 25 per cent water are, I believe, on the market.

High moisture and high sulphur often cause coal fires. Foreign materials in the coal, such as straw, wood, or rags, are capable of causing combustion. It is best to store a carefully selected deep mine coal. Sized coal should be used because the finer coal in run of mine and slack coals present a much greater area to absorb oxygen than do the lump coals.

W. N. S. may save himself the expense of capping his coal if he will store it in layers 2 to 3 ft deep and pack each layer. This should eliminate enough air circulation to prevent hot spots appearing. However, if hot spots do develop, capping the coal should cause it to cool down and there should be no more trouble.

Stored coals should be checked regularly for temperature with thermometers or with some other temperature indicating devices, such as thermocouples. Thermometer wells in the coal can be made of ¾-in. pipe closed at one end. If a thermometer well is removed from the coal, the hole should be filled and tamped to prevent air circulation. The danger point for many coals is 150 F.

Coal fires can be smothered by capping or by use of carbon dioxide, CO_2. The latter can be obtained as a solid (dry ice) or as a liquid in tanks. There is an article in Power, January, 1942, about putting out coal silo fires with CO_2. Water should never be used to put out fires in stored coal as its use will probably cause other fires to start later.

CHARLES E. DAY, JR.

Linthicum Heights, Md.

Editor's Note—In our original replies to both questions, we referred the questioners to Information Circular No. 7235, The Storage of Coal, by J. F. Barkley, obtainable without charge from the U. S. Bureau of Mines, Washington, D. C. This publication covers the fundamentals of storage both for outdoors and for silos and bins. It gives the results of years of study and experience of the Bureau, with this subject. Any reader with coal storage problems should consult the Bureau or get in touch with his local or regional representatives of the National Fuel Efficiency program.

For capping the coal in silos and bins, the Johnson-March treatment described on page 154, February, 1944 issue might have some application.

Another idea suggested by coal experts to prevent trouble is to store a dedusted coal, on the ground that the de-

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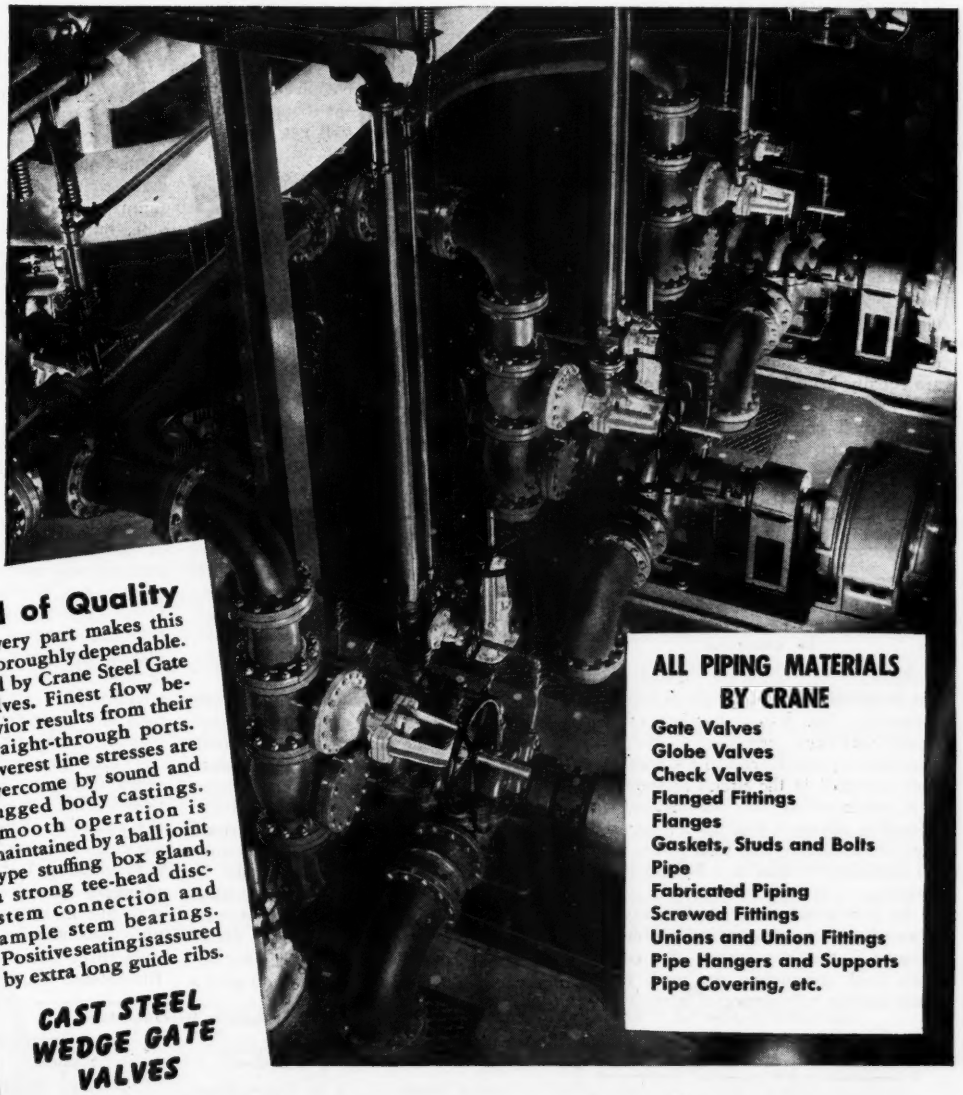

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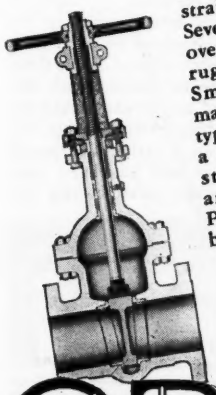

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dusting treatment tends to inhibit spontaneous combustion.

Concerning Mr. Day's suggestion to W. N. S. that he pile the coal in 2 or 3-ft layers in his underground storage bin, rolling and packing each layer, we wonder if this would be improved by putting a thickness of Kraft paper between layers, lapping it well over the sides, somewhat along the line suggested on page 93, April 1943 issue. This method has been effectively used on outdoor coal piles and while it would require some maneuvering to do it in a bin, it might help.

For injecting CO_2 into a fire or hot spot, some coal experts recommend the use of a water spear, a 1-in. or 1½-in. pipe closed at the bottom in a sharp point with holes drilled all around the pipe above the point.

Answer No. 262

How Connect Single-Phase Wattmeters to Measure Two Parallel Generators?

IN THE JUNE issue, C. R. D. asked if and how he could use one single-phase indicating wattmeter in each of two 3-phase a-c generator circuits in parallel to measure the output of the individual generators.

How to Connect the Meters

IT IS POSSIBLE to use one single-phase indicating wattmeter to measure the power in a 3-phase generator circuit. The single-phase reading multiplied by three gives the total power. However, the result will not be accurate unless the three phases are equally loaded, that is balanced.

If a Y-box is utilized as in Fig. 1, the total circuit power will be indicated by the one wattmeter, no multiplication being

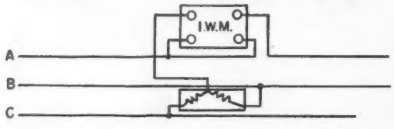

Fig. 1. Diagram by Joseph A. Kendrick showing how a Y-box and a wattmeter can be connected

necessary. Here again the indication will not be accurate unless the phase loads are balanced. The Y-box consists of two equal resistances, each equal to the resistance of the potential coil of the wattmeter and connected in the circuit as shown.

A minimum of two wattmeters, connected as shown in Fig. 2, is required to measure accurately the total power under all conditions of load in a 3-phase, 3-wire circuit.

An iron-bound rule, which always applies when measuring power in polyphase circuits, is that in a system of n conductors, n—1 wattmeters are used, having their current coils connected in any (n—1) of the conductors and the potential coil circuits to the remaining conductor.

Baltimore, Md. JOSEPH A. KENDRICK

Single-Phase Meter Won't Do It; Use Polyphase Meter

USE OF AN indicating wattmeter to determine the load of a 3-phase generator requires, for accurate results, one polyphase (2-element) meter with two current and two potential coils; this assumes an ungrounded system. There is no convenient or even approximately correct method in practical application for accomplishing the result with a single-phase meter and using a multiplier, except for one single case: when the power factor of the load is exactly 100 per cent and exactly balanced in the voltages between lines and the current per line. It is clear such a condition is a purely hypothetical one since, even for lighting circuits alone, the power factor is not 100 per cent exactly.

The reason one meter cannot be used is clear when one studies the characteristics of a 3-phase circuit, as given in elementary text books and observes the changes in the angular relation of the voltages and currents in the two meter elements. This applies, of course, to two separate single-phase indicating wattmeters or to one polyphase meter which combines two meters in one case with one pointer acted upon by both elements so that the indication is the vector resultant of the two elements. A full explanation would require too much space but, as a matter of pertinent interest, the tabulation below gives the relative readings of the two associated single-phase meters or those of the elements of a 3-phase meter for a constant load and varying power factor:

The foregoing tabulation explains clearly why the use of one single-phase meter with a multiplier is impossible except for the theoretical condition of 100 per cent power factor together with balanced voltages and current. It is also clear that the single-phase reading will depend upon which combination of voltage and current is measured, depending on the phase sequence of the system (incorrectly termed phase rotation).

It is of particular interest to observe that at exactly 50 per cent power factor one meter or one element of a polyphase meter will indicate zero; for any power factor of less than 50 per cent one element will give a negative reading. In other words, the single-phase meter will read backwards and unless it has a zero-center scale, the potential connections must be reversed to give a reading up-the-scale. The polyphase meter takes care automatically of the changes due to power factor variation since the effect of the two elements is combined on one shaft to give a resultant reading of the actual condition on one scale. This is a positive advantage over two single-phase meters where the difficulty of taking two separate readings of a varying load is clear, when it is attempted to obtain even an approximately accurate reading.

It would, of course, be possible, as is done in a laboratory with skilled testers, to use one single-phase meter with the necessary switching devices to obtain the required readings. Such a method is not recommended, however, except as a temporary makeshift, due to its uncertainties with load of varying power factor and the complications due to the switching devices needed, as well as incorrect interpretations of the readings.

To conclude, the recommendation to the questioner is to use a polyphase indicating meter.

Brooklyn, N. Y. C. O. VON DANNENBERG

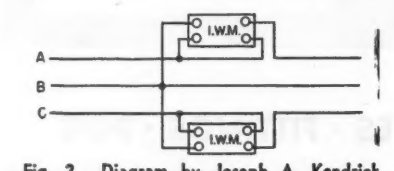

Fig. 2. Diagram by Joseph A. Kendrick showing how to measure total power in 3-phase circuit

Power Factor Per cent Lagging	Relative Meter Reading in per cent of: Polyphase Element 1 or Single Phase Meter 1	Polyphase Element 2 or Single Phase Meter 2	Total Reading Per Cent
100	50	50	100
90	64	36	100
86.6	66.66	33.33	100
80	71.7	28.3	100
50	100	0	100
40	116	—16	100
30	141.6	—41.6	100
20	192	—92	100

Answer No. 263

Why Forbid Flax Packing on Water End of Pump?

A RECENT RULING in S. J. A.'s plant puzzled him. It was that, from now on, no flax packing was to be used on the water ends of reciprocating boiler feed pumps, as had been done for a long time, but only steam packing. There had been an epidemic of gland and packing nut breakage on both steam and water ends but this stopped after the glands were replaced. Was there any connection between the two? He had always been taught that flax packing was best for the water ends and his experience had confirmed it. Why forbid it now? They had plenty of flax packing, so it wasn't a supply difficulty.

Shoulders on Plungers Cause Gland Breakage

REFERRING to the gland breakage on S. J. A.'s boiler feed pumps, I doubt if the use of flax packing was the cause of breakage unless hard or inferior packing was used.

I had a similar experience with a Dean Triplex power feed pump. Each time the plungers were repacked or the glands tightened, there would be one or more glands or studs broken. Flax packing 5/8 in. sq has been used on this pump for some time, therefore breakage was not caused by packing.

These plungers were found to be worn, forming a shoulder on each end, thus having a wedge effect. Each time the shoulder came in contact with the packing, it caused an excess strain on both gland and studs. After having the plungers turned in a lathe, the pump was put in service and has been running continuously and satisfactorily for over three years.

Blackstone, Mass. WM. E. SHOULTZ

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Answer No. 264

What Causes Stoker to Smoke and Gas from Hopper?

Put Hopper Under Pressure

A HOPPER in an underfeed unit smokes when the resistance through the fire-bed is greater than the resistance back through the coal-feed pipe and the hopper; and both of these resistances vary.

In some industrial installations fine coal is mixed with the larger coal with the idea of closing the interstices. This is not a good plan when steam is needed for power.

By some a cross-pipe is rigged from the wind trunk to the fuel pipe. This is no good. It puts air into the fuel pipe; but the air then flows along the path of least resistance. At certain stages of the fire the air may flow towards the retort.

In a unit of moderate size, I decided to raise the air pressure in the hopper, closing the hopper by a door or cover. I connected a branch air duct, valve controlled, from my air trunk to a high point in the wall of the hopper; and I also put a butterfly valve in the air trunk beyond the branch connection. By the aid of these two valves I am able to adjust the air flow to the retort, direct; and also the air flow to the hopper. The air branched to the hopper goes through the coal and through the fuel pipe to the retort, where I have found that it aids combustion and reduces the formation of coke-trees. There is no smoking.

Richmond, Va. ARTHUR SCRIVENOR

Incorrect Air Flow the Principal Cause

E. K.'s STOKER is emitting smoke to the boiler room because the resistance to the flow of air from the blower connection is less through the coal to the hopper than through the fuel bed. Solutions can be divided into two classes, (1) increase the resistance to air flow back through the green coal, or (2) decrease the resistance through the fuel bed.

With the rebuilt stoker, the operators may be carrying too heavy a fuel bed. In any underfeed stoker, the draft loss is practically all in the fuel bed, rather than in the air ducts supplying the air or the tuyeres. Clinker formations are a common cause of air and gases blowing out. Some fuels form a clinker that completely bridges over the tuyere stack, shutting off air admission to the furnace. Furnace draft has little effect on this type of blow-back. A draft survey will establish whether or not the loss through the fuel bed is normal. At the same time, fuel bed shape, thickness, and freedom from clinkers should be carefully checked.

The blower connection should be examined with respect to direction of air flow. Possibly a baffle can be installed to direct air to the tuyere stacks. Existing dampers should be checked at all positions for their effect on direction of air flow. The steam production should be measured or estimated as a check on rate of operation, since in many installations boiler output is limited by draft. If furnace draft is positive, gas discharge is unavoidable.

Another factor to check is coal segregation, since the resistance to air flow through a fuel bed varies greatly with particle size. Segregation in bins and hoppers may contribute to the condition described. See answer to Question 248, page 120, May issue, also Coal Segregation in Boiler Plants, August, page 71.

In other cases, very dry coal may give off volatile matter in the feeding zone with resultant blow back of gas. A small water spray will correct this fault usually without any appreciable loss in efficiency since the addition of moisture tends to improve combustion control.

If the fault is due to factors which cannot be altered, the gas can be kept from the boiler room by housing the stoker front and ventilating with a fan or connection with damper to the stack. The housing may be sheet metal or asbestos board. Inspection doors can be fitted for stoker adjustments.

Saint John, N. B. C. G. CLARK

Answer No. 265

What Is Eating Up the Fusible Plugs?

WHEN M. G. asked in the July issue what was the cause of the electrolytic or "battery" action that the insurance inspector said was eating up the fusible plugs in his 72-in. by 18-ft hrt boilers, we wondered if the diagnosis of electrolytic action was correct or if this was just a case of normal plug deterioration. Several readers thought it was probably the latter and this situation is best summed up by C. C. Custer below.

May Be Normal Deterioration, Not Electrolysis

LOSS OF THE filling material in a boiler fusible plug does not necessarily indicate that there has been electrolysis action in the boiler, as it is a common occurrence in both land and sea boilers to have this kind of trouble. A fusible plug is not 100 per cent perfect as a safety device. In use, it may deteriorate so as to blow too soon, too late, or not at all. In recognizance of this fact, the marine rules call for all fusible plugs to be replaced with new ones at each annual inspection, whether the plug shows external evidence of depreciation or not.

In land use with fresh water boilers this rule is not so strictly enforced by boiler inspectors as long as the plug appears to be sound and in good condition. In the attached Fig. 1 (from an article by the writer in *Power* some time ago), A shows deterioration of plug from flame side, showing how a plug is liable to overheat on this side and lose part of its filling. At D is a case where the plug has lost part of its filling on the water side and at this end the hole in the plug has been entirely filled with lime deposit, thus making a plug that will not blow at all. C shows a case where the filling has come unsoldered from its case, allowing a slight leak past the core, which in time limes up tight. E shows a loose core where the water has seeped past and limed up the plug at the flame side. F shows the core that fell out of plug E when the plug was sawed in two. Expansion coefficient of brass and tin are not the same.

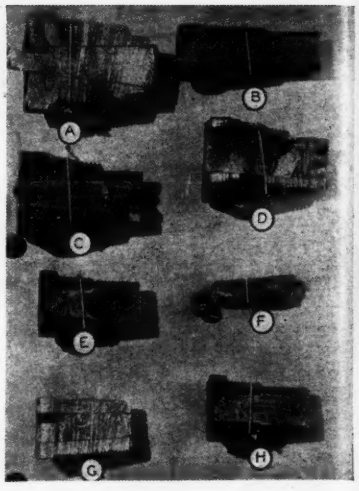

Fig. 1. Fusible plugs that have become defective in service

Note in A how the filling is beginning to bulge out at both ends showing depreciation. G shows a plug in which the core is beginning to work loose from the shell and a little of the core has already melted out on the fire side.

The following conditions are sufficient reasons for condemning a plug:

(a) Plugs of wrong type or defective design or that stick out into the flame pass too far.

(b) Plugs that leak either around the thread or at the core.

(c) Plugs in which the core has slipped or bulged at either end.

(d) Plugs in which the fire end shows the characteristics of tin oxide which melts at a considerably higher temperature than metallic tin.

(e) Plugs that have been in use for too long a time.

Attention is directed to the improved design now standardized by the Government for marine use shown in Fig. 2. Our only criticism of these is that they are evidently built for Scotch marine boilers that have a shell one inch thick. When used with an hrt boiler with a shell 5/8 inch thick or less, the head is likely to stick out too far into the flame pass and thus cause overheating at this end.

We would advise M. G. to renew his fusible plugs at least yearly or as often as they show signs of deterioration and not worry about electrolysis, unless the boiler shows signs of electrolysis acting on it in other places.

Logansport, Ind. C. C. CUSTER

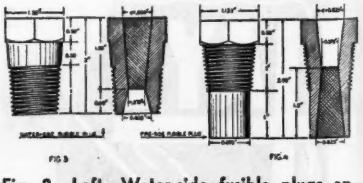

Fig. 2. Left—Water-side fusible plugs approved for marine service. Right—Fire-side fusible plugs approved for marine service

Effective FEED WATER *Control*

BEGINS AT THE PUMP GOVERNOR...

Boiler feed control properly begins at the feed pumps, through maintenance of fixed excess pressures. For this purpose it pays to specify Copes Pump Governors.

Every Copes Pump Governor is "tailored" to the specific application. This means not only selection of one of nine styles of inner valve fittings, but also design of the port area for existing flow and pressure conditions. Such individualized design results in maximum sensitivity of regulation and minimum wear.

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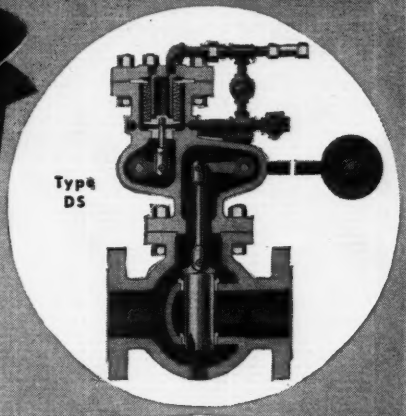

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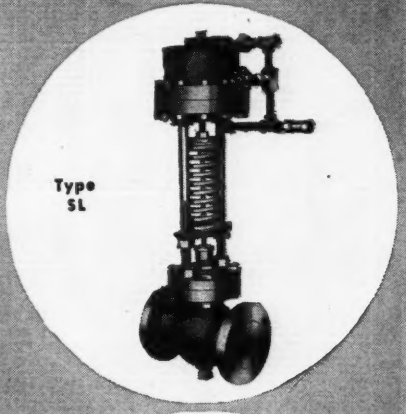
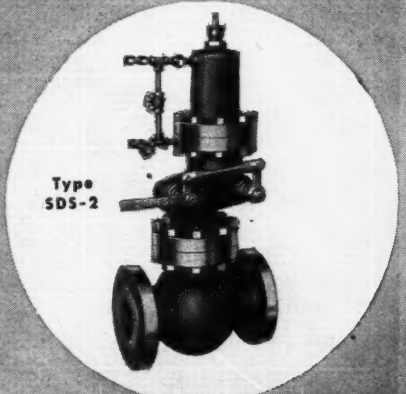
Service—particularly suited to turbine driven pumps.
Controlled Excess or Constant Pressure Limits—10 to 75 psi.
Sizes—¾- to 4-inch, 250- and 300-lb. stds.
Special Features—Rotating stems, weight loaded, low cost.



COPES *Type SL Governor*

Service—particularly suited to reciprocating steam driven pumps.
Controlled Excess or Constant Pressure Limits—10 to 75 psi.
Sizes—¾- to 3-inch, 250-and 300-lb. stds.
Special Features—Large 4-ply bellows, tight seating inner valve, spring loaded, moderate cost.



COPES *Type SDS-2 Governor*

Service—for severe conditions with any type of pump.
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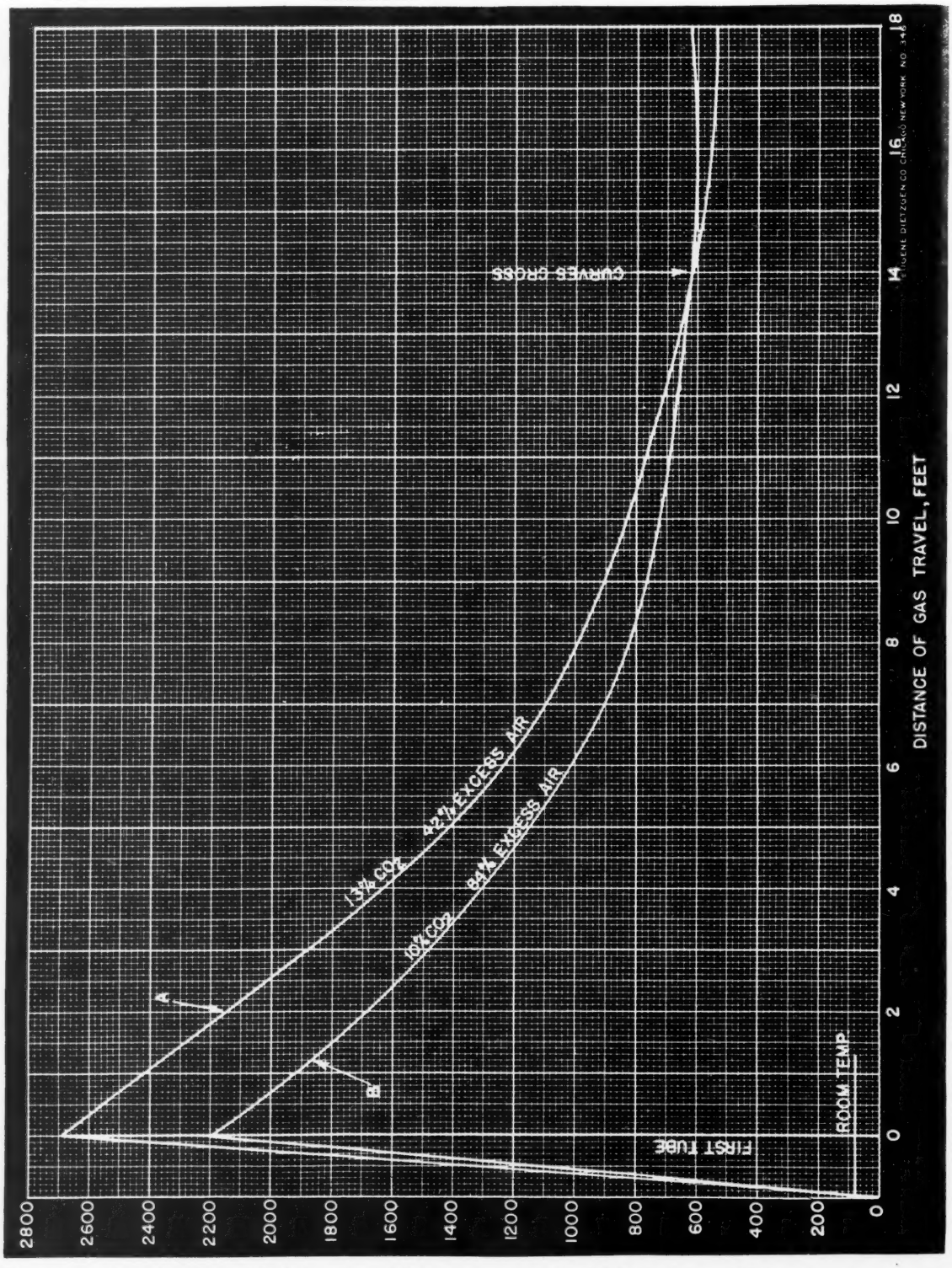
Effect of Excess Air and CO_2 on Furnace and Flue Gas Temperatures

(See Boiler Fireman's Handbook, page 114 this issue)



These curves show the effect on both furnace and flue gas temperatures with bituminous coal firing when the excess air is doubled and the CO_2 reduced. The flue gas temperature is lower with the higher furnace temperature

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The last four years have been hard ones on machinery . . . heavier loads, faster speeds, longer hours of operation, scarcity of replacement parts. But here's a case where four ammonia compressors in a large ice and cold storage plant have had smooth sailing despite wartime hardships. One reason — they adopted Suniso Oil four years ago.

Trouble with carbon and sludge was experienced before that time. Every year they had to make forced shutdowns for cleaning and adjustments during the busiest season. Also their lubrication bill was high because, due to congealing, it was difficult to reclaim oil that carried over into the cooling system.

Since changing to Suniso they have had trouble-free service. In fact, in four years not one valve has been replaced . . . or even refaced! There have been no forced shutdowns . . . no mechanical difficulties . . . and the annual check-up always finds the compressors free of carbon and sludge. With Suniso, the oil which is carried over is easily reclaimed . . . thus lowering costs.

This performance is typical of the whole line of Sun quality lubricants. No matter what mechanical equipment you have, there's a Sun lubricant to increase its efficiency. As an added service Sun offers you without cost or obligation the new "Save and Serve" Plan to help you save time . . . equipment . . . labor. Write for folder describing it!

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SUNOCO

SUN INDUSTRIAL PRODUCTS

HELPING INDUSTRY HELP AMERICA

Shasta—Key to Central Valley

(*Continued from page* 81)

The rotating parts of the generator have a calculated flywheel effect (WR^2) of approximately 84,500,000 lb at a radius of one foot. A brake ring having a removable and renewable wearing surface is installed on the rotor. The shaft is made of forged open-hearth, heat-treated, steel, and has a 6-in. diam hole bored axially throughout its length and finished to permit visual inspection of the metal in the interior of the shaft.

Each generator is equipped with a spring-type thrust bearing located above the rotor and two guide bearings, one located above and the other below the rotor.

Air-operated brakes designed to bring the rotating parts of the generator and turbine to rest from one-half rated speed within 7½ minutes after application are provided. The brakes may also be used as hydraulic jacks to raise the rotor off the thrust bearing. The brake shoes are equipped with renewable wearing surfaces.

The main exciter is mounted on top of the generator and the pilot exciter is mounted on top of the main exciter. The armature and field windings of both exciters are insulated with class "A" insulation. The excitation system is designed for a speed of response of not less than 0.5. The nominal excitation voltage is 250 v. Automatic voltage regulators are provided, which are sensitive to changes of 0.5 per cent in the generator voltage, and which will respond in 0.05 sec after the generator voltage has departed from normal by 1.5 per cent.

Main Transformers

Main transformers are of the single phase, oil-immersed, forced-oil-cooled, inert-gas-filled, outdoor type, each having a rating of 25,000 kva, 60 cycle, 13,600 v delta to 230,000 v star. The core of each transformer is constructed of high-grade, non-aging, low-loss steel sheets. Both sides of each sheet are insulated with baked-on varnish. The high-voltage winding of each transformer is insulated for full voltage on the line end, and for 138,000 v on the neutral end, the insulation being so graded to the neutral end that it will be satisfactory for operation with a future ground-fault-neutralizer.

There are no taps in either the high-voltage or low-voltage windings.

The transformers are designed for a maximum temperature of not to exceed 80 C (176 F), when delivering rated output continuously, with cooling water at a temperature of 25 C (77 F). Each transformer is equipped with one 230,000-v high-voltage line bushing, one 138,000-v high-voltage neutral bushing, two 15,000-v low-voltage bushings, a magnetic-type oil gage, a dial-type indicating thermometer, a thermal relay with contacts for sounding an alarm, and a 10-ohm-resistance temperature detector.

The transformers are mounted on trucks equipped with double-flanged wheels, and are supported on rails having a 7-ft gage. Automatic inert gas equipment, designed to maintain an adequate supply of inert gas in the transformer case under a normal positive internal pressure of not to exceed 5 psi, is mounted on the transformer case. Internal pressure in excess of 10 psi is relieved by a relief valve, which is equipped with alarm contacts to indicate the operation of the pressure relief valves. Pressure devices with alarm contacts indicate abnormally high or low gas pressure in the transformer tank. Each transformer is provided with two heat exchangers.

Station Service Turbines

The station service turbines are of the vertical-shaft, single-runner, Francis type, with cast-steel spiral casings, and have a rating, at full gate and at a net effective head of 290 ft, of 3,500 hp which corresponds to the generator rating 2,500 kw at unity power factor. The capacity of each turbine is not less than 2,150 hp when operating at rated speed under a net effective head of 238 ft. The turbines will operate at a normal speed of 600 rpm. The governors are of the oil-pressure, relay-valve, gate-shaft type with electrically-driven, speed-responsive elements. Provision is made for retarding the rate of turbine gate closure similar to the main turbine. The station service generators are of the vertical-shaft, water-wheel-driven type with direct-connected main and pilot exciters. These generators are each rated 2,500 kva, 0.8 power factor, 60 cycle, three-phase, 2,400 v, 600 rpm.

Shasta Switchyard

The Shasta switchyard is on the hillside across the river from the power plant. The initial installation consists of two transformer circuit positions and one outgoing line position, and a combined oil and battery house, all within a steel fence enclosure. The 230-kv bus structure is of latticed steel construction. The main power equipment consists of six 230-kv single-throw and three 230-kv selector-type disconnecting switches; five 230-kv oil circuit breakers; and three 230-kv single-pole lightning arresters. Control cables, between the control room in the power plant and the equipment in the switchyard, cross the river through a gallery in the dam.

The ultimate switchyard installation will consist of five transformer positions and three outgoing line positions, complete with the necessary switching, protective, control and auxiliary equipment.

Disconnecting Switches

The disconnecting switches are rated 230,000 v, 1,200 amp, and are of the outdoor, manually-gang-operated vertical-break type for horizontal mounting on steel structures. Six of the switches are of the single-throw type and three are of the type having two blades per pole hinged at the ends of the pole with a common clip at the center stack of insulators. The switches are equipped with self-aligning, high-pressure contacts designed to release contact pressure before the blades move in the vertical direction, and to apply contact pressure after the blades have completed their vertical travel in the closing direction. The switches are designed for a temperature rise of 30 C above an ambient temperature of 40 C. Grounding blades of the manually-gang-operated type are installed on the clip ends of the bus selector switches.

Oil Circuit Breakers

Two types of oil circuit breakers are installed in the high-voltage switchyard, one being the steel-tank type and the other the porcelain-enclosed, impulse type. Both types have a rating of 230,000 v, 800 amp, 60 cycles, and an interrupting capacity of not less than 2,500,000 kva at rated voltage and frequency, and are of the triple-pole, single-throw, outdoor, nonoil-throwing, full-automatic type.

The tank type breakers are designed for an opening time of not to exceed 8 cycles, on a 60-cycle basis, when interrupting from 25 to 100 per cent of their interrupting rating, and an opening time of not to exceed 12 cycles when interrupting from 0 to 25 per cent of their interrupting rating. The porcelain-enclosed type breaker is designed for an opening time of not to exceed 3 cycles when interrupting from 0 to 100 per cent of its interrupting rating. The opening time is defined as the interval from the time when the trip coil is energized until the current is interrupted.

Both types of breakers are designed for a closing time of not to exceed ½ sec when measured from the time when the closing coil is energized until the breaker contacts close.

The tank type breakers are pneumatically operated. The porcelain-enclosed breaker is operated by a system of springs which are in turn motor operated.

Lightning Arresters

The lightning arresters are of the 230,000 v, single-pole thyrite type and are suitable for outdoor use on a three-phase, grounded neutral circuit. The arresters are designed so that when discharging the AIEE standard surge current of 1,500 amp, the ratio of the crest value of the impulse voltage across each lightning arrester to the crest value of the voltage rating of the lightning arrester will not exceed 2.5. The arresters are designed for a maximum 60-cycle, dynamic, line-to-ground, root-mean-square voltage of 195 kv, and for suspension mounting.

Engineering and Supervision

The Shasta Power Plant was designed under the direction of L. N. McClellan, Chief Electrical and Mechanical Engineer. The Shasta storage and power development was designed under the general direction of J. L. Savage, Chief Designing Engineer. The engineering and construction work of the Bureau is under the general direction of S. O. Harper, Chief Engineer, Bureau of Reclamation, with headquarters at Denver, Colo.; and all activities of the Bureau are under the general charge of H. W. Bashore, Commissioner of Reclamation, Washington, D. C. C. E. Carey is in charge of the Region No. 2 office of the Bureau of Reclamation, with headquarters at Sacramento, Calif. Ralph Lowry is the Construction Engineer under whose direction the dam and power plant are being built. His headquarters are at Redding, Calif.

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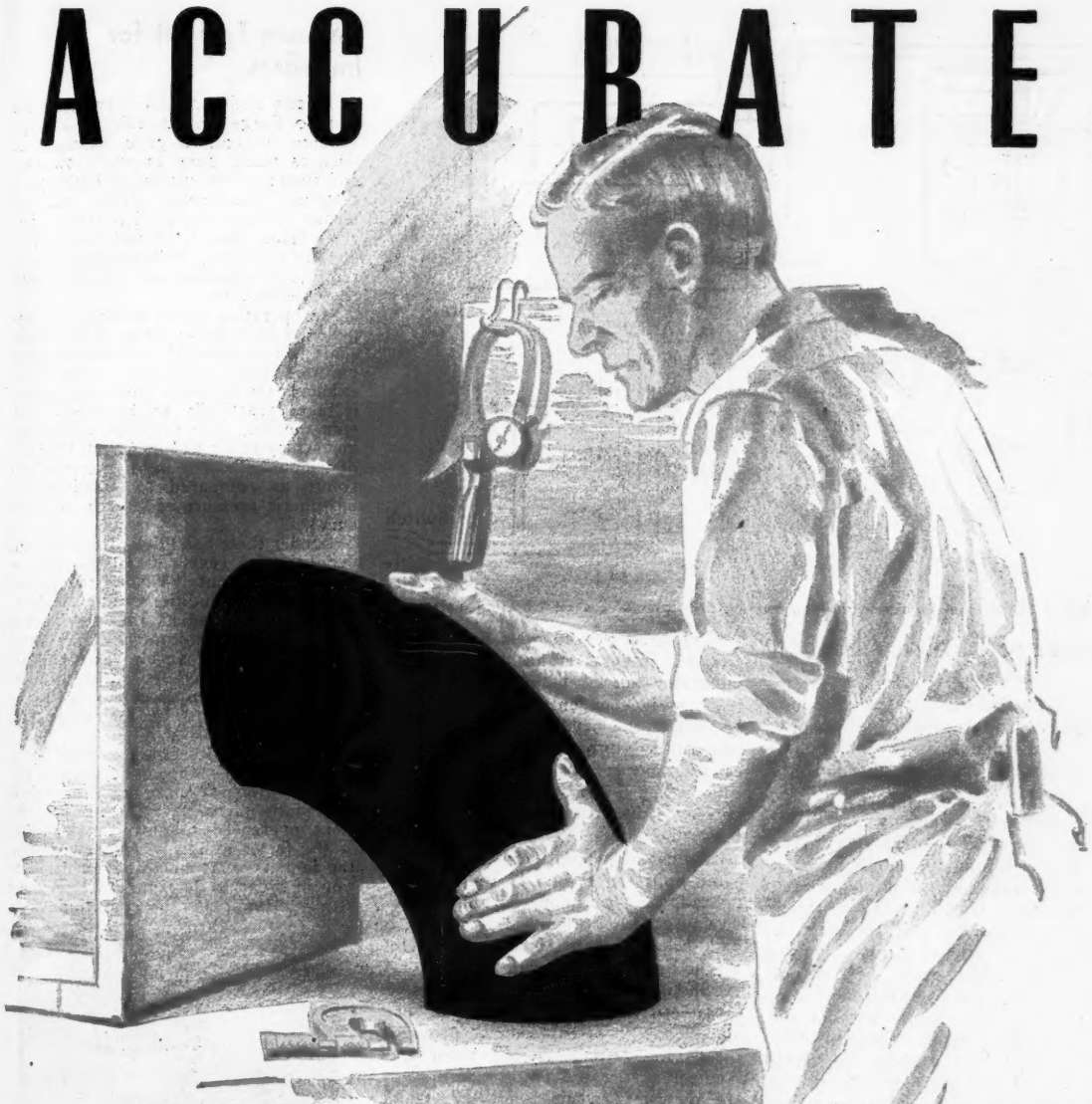

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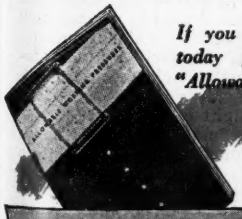

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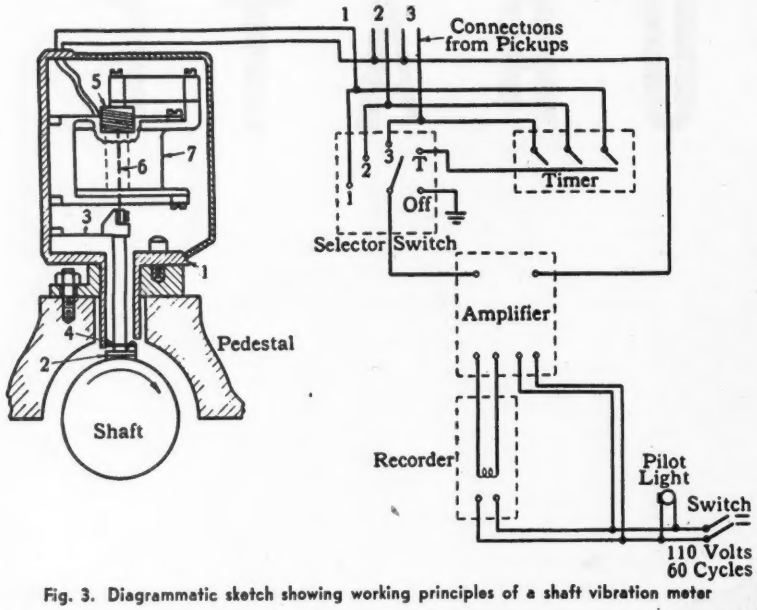

Fig. 3. Diagrammatic sketch showing working principles of a shaft vibration meter

Causes of Turbine Vibration

(*Continued from page 89*)

through the failure of traps or drains to remove condensate from the exhaust or extraction lines. This condition is another cause of vibration.

Shaft Vibration Meter

No turbine operator wants vibration but only rarely does one find a unit that is so smooth running that it will not operate a vibration tachometer. By constantly watching the vibration characteristics of his unit, the operator is warned by any abnormal changes that may be taking place. If a change occurs rapidly, the operator can sometimes detect the change without the aid of an instrument. On the other hand, if it is very gradual, the effect may not even be noticed. The use of a recording instrument in such instances is exceedingly helpful.

One type of shaft vibration meter is shown diagrammatically in Fig. 3 and its operation is as follows:

The pickup frame "1" bolted to the turbine pedestal supports the shoe "2" on a shaft rider through springs "3" and "4". These springs also supply the necessary force to hold the shoe against the rotating shaft under all conditions of vibration. The pickup coil "5" is connected to and vibrates with the shoe through the connecting rod "6". The coil is located in a magnetic field supplied by permanent magnet "7" and by virtue of its motion generates a voltage proportional to the product of the amplitude and frequency of vibration. The magnet assembly is seismically supported in the frame by four flat springs and is practically motionless in the direction in which vibration is measured. The shoe rides on the shaft just outside the bearing and receives sufficient lubrication from the bearing discharge.

The general voltage is fed into an electrical integrator and amplifier. The integrator serves to make amplitude readings independent of the frequency or rpm of the machine and, therefore, proportional only to actual amplitude at any speed between 600 and 4000 rpm. The integrated and amplified current is then fed to the recorder, calibrated in thousandths of an inch.

If several pickups are used on the same unit, the record of each station is made on a common chart in successive and periodic intervals, the length and order of which is determined by the setting of a program timer.

Should the operator be interested in one particular station, he may use a selector switch which provides means for cutting out the timer and connecting the pickup in question to the metering circuit.

Due to the extreme care usually given steam turbines, wrecks of these units seldom occur but when they do happen they are always costly to the owner not only in property damage but also in operating time lost, and too often in the loss of lives of attendants. Safety demands that no person should be placed in charge of the operation of a steam turbine until he has had thorough instruction in the operation of the particular unit he is to operate.

Rupture of the rotating parts and bursting of the casing are the things most to be feared in the operation of a turbine. Accompanying such failures, however, is nearly always a release of great quantities of steam that multiplies the danger to persons in the vicinity of the wreck.

Turbine operators must recognize that vibration is only a symptom of some undesirable condition that is interfering with the safe and efficient operation of the turbine, and the location of the cause is the next step in its correction.

Vacuum Test Pit for Impellers

In the Research Laboratory of the Buffalo Forge Co., Buffalo, is a large vacuum test pit, a good example of what is being done to study stresses and improve the quality of high speed rotating machinery. The pit,—so termed because the shell is set in concrete below floor level, is 6 ft in diameter by 4 ft deep. It is made of heavy, reinforced construction to withstand absolute vacuum.

In operation of the test pit, the impeller to be tested is hung by a slender shaft from a small air turbine mounted on the cover. A vacuum pump then exhausts the air from the drum so that it takes practically no horsepower to spin the fan. The pressure within the drum may reach as low as 200 microns of vacuum (0.00787 in. of mercury absolute as compared to standard atmospheric pressure of 29.92 in. of mercury).

Under these conditions the power to drive the fan (exclusive of the turbine friction) is about 1/4000 of the power under normal conditions. The acceleration must be gradual, the speed being under the constant control of the operator by means of an air valve and air brake. In order to keep the speed indicating device from absorbing power at the higher speeds, an electronic frequency meter is used.

Several purposes are served by a test pit of this type. To insure the safety of operation of cast or fabricated fans, the fan may be run at sufficient overspeed to permit calculation of the factor of safety. On new design, the impeller may be tested to destruction in order to determine the weakest section or unpredictable condition.

Pit for testing fan impellers under vacuum pressure

For this reason there is supplied a laminated shield within the main shell so that the force caused by rupture will spend itself against this shield and not seriously harm the shell which maintains the vacuum. A check on fan balance can be made on high speed impellers that might otherwise be impossible, except at final installation. Thus, a fan that would require 1000 hp to drive normally can be operated in a vacuum of 200 microns of mercury by ¼ air horsepower. Then there is an opportunity to study stress conditions while the unit is in operation. A glass aperture in the cover of the pit permits visibility of the impeller by stroboscopic light. Also through the use of strain gages in circuit with a cathode ray oscilloscope, stresses and vibration may be visualized and measured.

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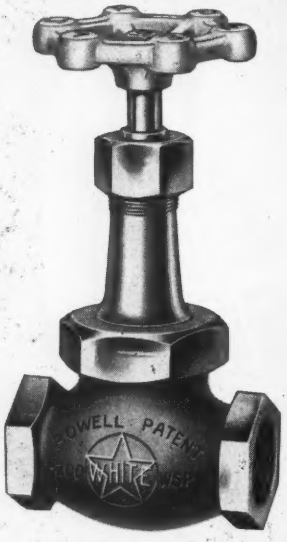

Fig. 1708—Bronze Globe Valves for 200 pounds W.S.P. Has screwed ends, union bonnet, renewable seat and regrindable, renewable nickel-bronze semi-cone plug type disc.

For every problem in flow control, there'll always be a POWELL Valve to lick it

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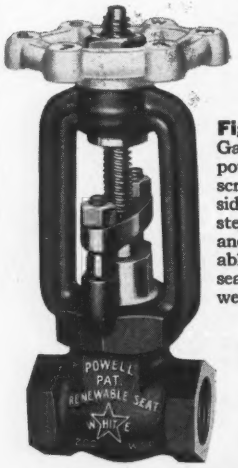


Fig. 386 — Bronze Gate Valve for 200 pounds W.S.P. Has screwed ends, outside screw rising stem, screwed yoke and bonnet, renewable nickel-bronze seat rings and taper wedge solid disc.

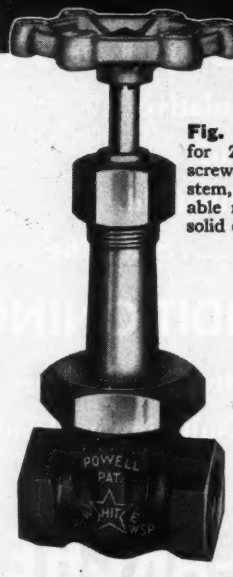
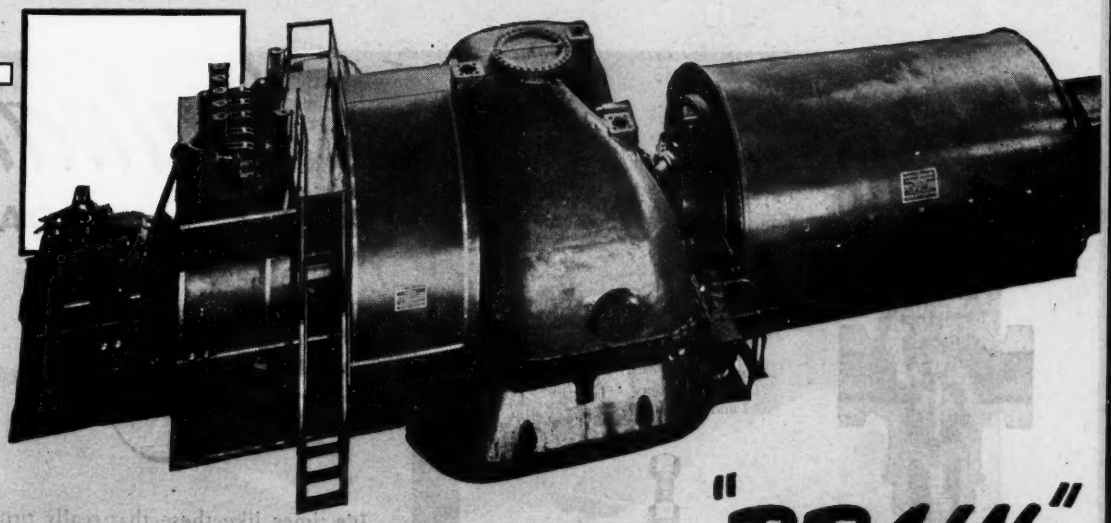


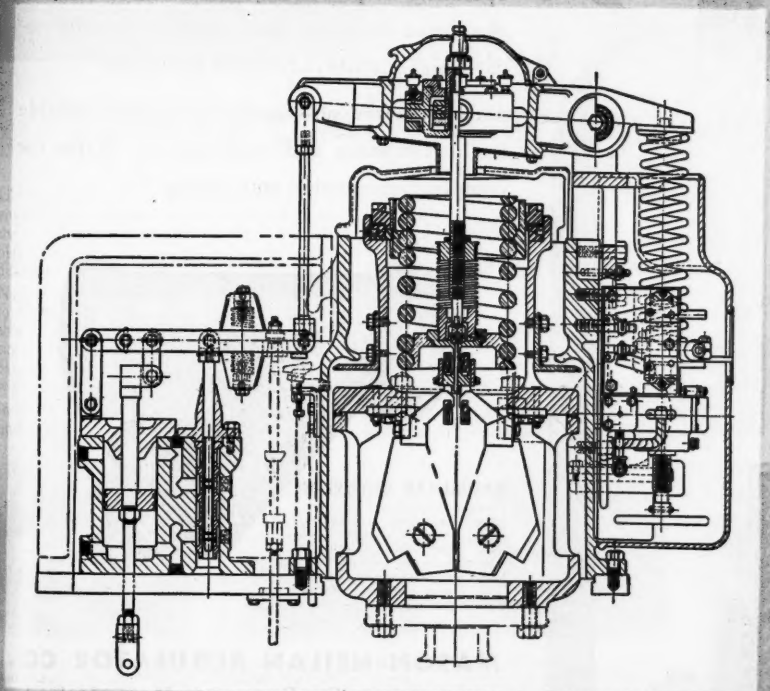
Fig. 375—Bronze Gate Valve for 200 pounds W.S.P. Has screwed ends, inside screw rising stem, union bonnet, and renewable nickel-bronze taper wedge solid or double disc.

Fig. 150—Bronze Globe Valve for 150 pounds W.S.P. Has screwed ends, union bonnet and renewable composition disc. (Discs of vulcanized rubber, phenolic resins, soft metal and bronze can be supplied to meet various service requirements.)

POWELL VALVES



Why that sensitive turbine "BRAIN" needs this better turbine oil



THE GOVERNOR mechanism of a steam turbine is as delicately balanced as a finely made watch. Yet the oil that lubricates this sensitive turbine part must also be able to withstand the high speeds and pressures encountered in lubricating the main and thrust bearings.

It is under these extreme operating conditions that ordinary turbine oils break down. They oxidize rapidly . . . develop rust. If the oil does not have the properties to resist oxidation and prevent rust, you have trouble on your hands.

Rust, which may either be formed in the governor or carried into it by the oil, gets into the delicate mechanism, causing it to stick. And when an oil oxidizes it may form lacquer and sludge which in turn "gums up" the governor.

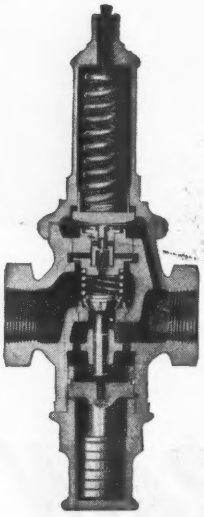
These are the problems Shell Engineers licked when they perfected Shell Turbo Oil. Developed expressly for turbine use, Shell Turbo Oil has *superior oxidation stability* as well as the ability to *prevent rust.* Drain and clean your turbines...then change to Shell Turbine Oil and you'll soon see *why* it was the first of its type to be approved as meeting rigid U. S. Navy specifications.

* * *

Get the full details from your Shell man today. Write Shell Oil Company, Incorporated, 50 W. 50th St., New York 20, N.Y., or 100 Bush Street, San Francisco 6, California.

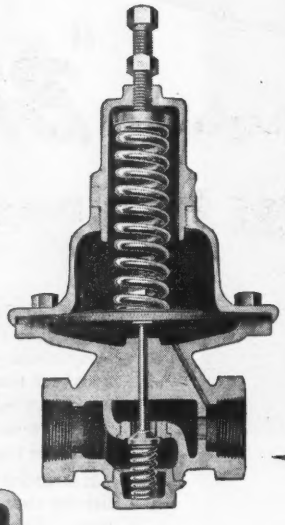
SHELL TURBO OIL

SHELL

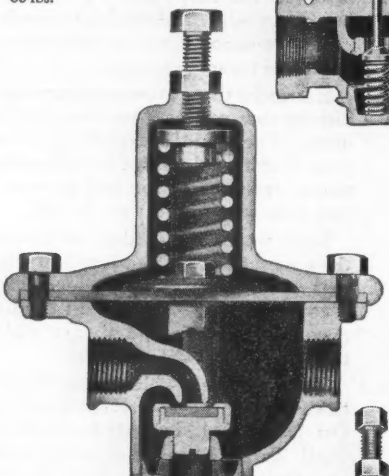


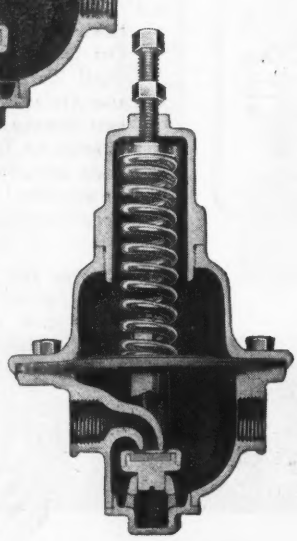
No. 11
For reducing steam pressures. Pilot operated. Sizes — Bronze up to 2"; Iron 2½"–4". Reduced pressure ranges between 5 and 225 lbs.

No. 33
For small steam lines, unit heaters or single radiators. Sizes up to ¾". Reduced pressure ranges between 2 and 100 lbs.



No. 227
For domestic or industrial water systems. Requires no attention for years. Sizes ¼" to 2". Reduced pressure ranges between 10 and 60 lbs.





No. 414
For reducing air pressure in industrial service. Recommended for dead end service. Sizes ¼" to 2". Reduced pressure ranges between 10 and 60 lbs.

Eliminate
CONTROL HEADACHES

It's times like these that really prove the value of Masoneilan Regulators. Installed in hundreds of plants, Masoneilan pressure regulators are working on round-the-clock schedules holding pressures at predetermined values in spite of fluctuating initial pressure or demand.

Manufactured under strict control by experienced craftsmen, they give years of dependable, accurate performance. Besides, their economical operation helps to keep down repair and replacement overhead thus counter-balancing today's higher costs of business operation.

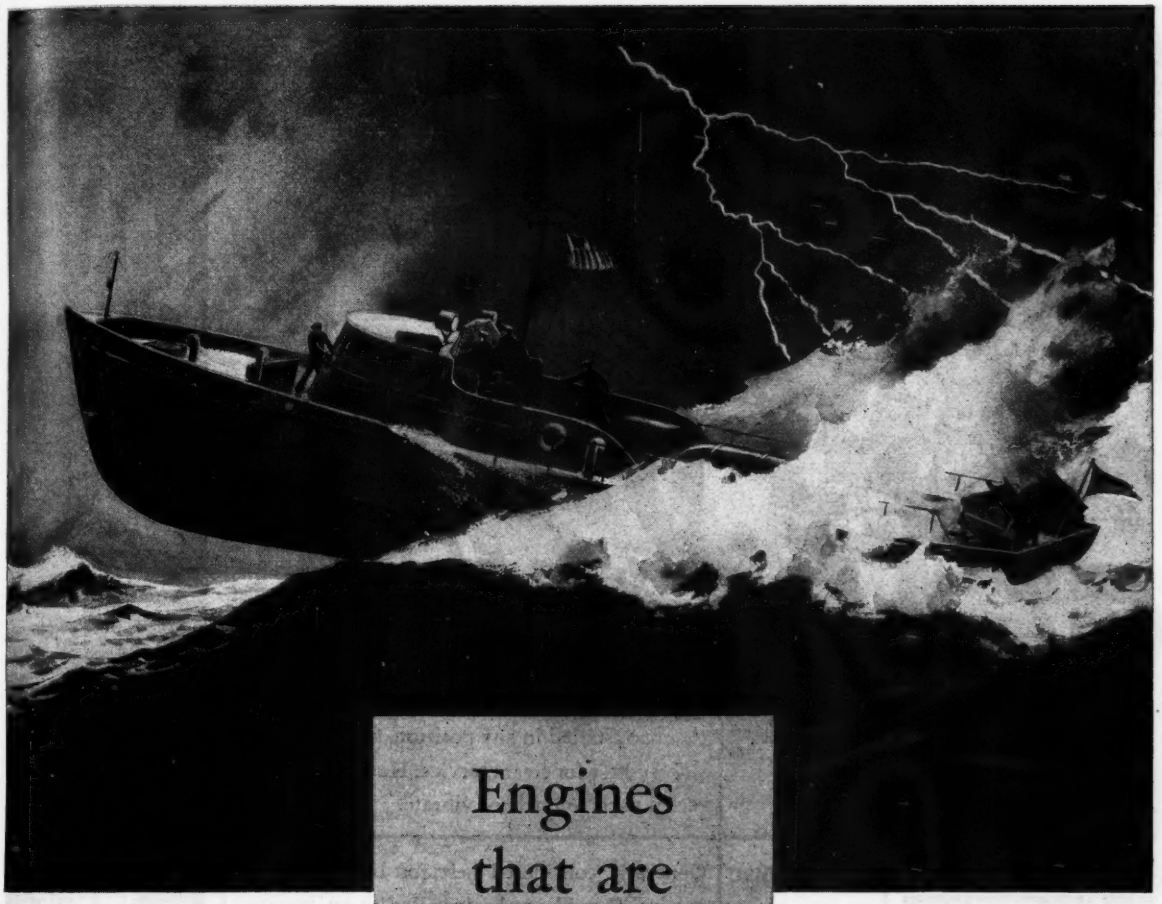
Masoneilan pressure regulators are now available for maintenance and replacement. Write for complete information and catalog 71.

MASONEILAN STRAINERS
Prevent scale, dirt, chips, etc. from damaging regulators, traps, valves and pumps . . . use Masoneilan Strainers. These precision-made strainers keep out all foreign matter. They'll eliminate maintenance delays and save you money.

MASON-NEILAN REGULATOR CO.
1207 Adams St., Boston 24, Mass., U. S. A.

MASONEILAN

New York Chicago St. Louis Philadelphia Houston
Pittsburgh Tulsa Los Angeles Toledo Atlanta San Francisco
Mason Regulator Co. of Canada, Ltd., Montreal, Canada



Engines that are "always ready" are ready for you—*now!*

Like the motto of the Coast Guard, Sterling engines have proved on the battlefronts of the seven seas that they are always ready to play their part in accomplishing the most difficult task missions.

Now you, too, can have Sterling engines for industrial power as rugged and dependable as those that drive our Coast Guard cutters through tropical storms and Arctic Seas protecting our convoys from the Axis wolf pack.

In these precision-built engines you will find many features you have long sought—more horsepower per pound of weight. That's because these engines are benefiting from the rapid advance in modern design. Furthermore, they give more economical operation than ever before.

NEW POWER FOR A NEW WORLD

We are ready right now to get together and discuss your engine needs. Our engineering skill and years of field experience are now at your disposal to help you select the most efficient war-time engine power for peace-time industrial applications.

STERLING ENGINE COMPANY, Buffalo, N.Y.
Offices in New York, Washington, Chicago.

Sterling engines drive the generator sets which provide emergency power for lifting the spans of draw bridges.

When disaster strikes, Sterling engines are ready in the emergency to supply the power for pumping stations.

Sterling engines supply the power for many of the fire boats of our leading cities and also drive the pumps.

Sterling engines are widely used in the oil fields of this nation both on drilling rigs and in pumping stations.

Sterling today is ready to supply you with stationary and stand-by power plants more rugged than ever before.

STERLING ENGINES

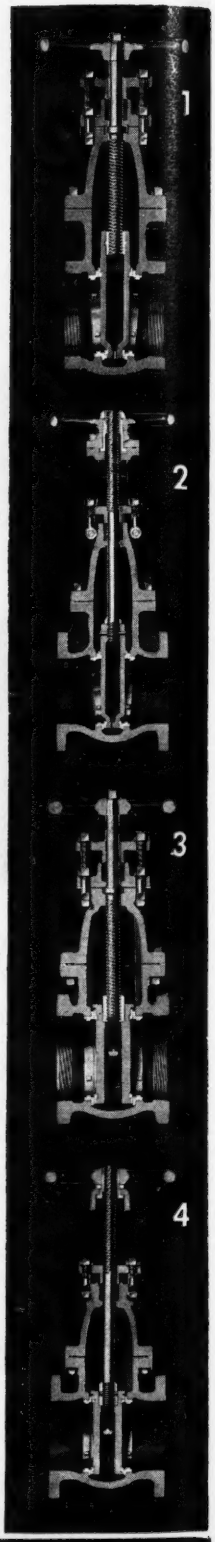
GASOLINE DIESEL GAS

"KEEP BUYING WAR BONDS"

Here is a simple chart for GATE VALVE SELECTION

Gate valves should be used where unrestricted flow is important. They should be used on lines where they will either be wide open or fully closed. They are not suitable for throttling or flow regulation.

TYPE	CHARACTERISTICS
WEDGE GATE	Can be installed in any position. Generally considered best for steam service. Have no loose internal parts to rattle or vibrate.
DOUBLE DISC	Generally considered best for liquid and gas service. Should not be installed in an inverted position.
OUTSIDE SCREW AND YOKE	Best for high temperature service. Advisable for corrosive service as stem threads are outside of valve chamber. Stem threads can be cleaned and lubricated. Position of stem indicates position of disc. Must have sufficient headroom for travel of stem when valve is open.
NON-RISING STEM	Necessary where headroom is limited. Undesirable on high temperature or corrosive service as stem threads are in contact with fluid or gas. There is no outward indication as to position of disc.



1. Kennedy Standard Wedge Gate Valve with Non-rising Stem
2. Kennedy Standard Wedge Gate Valve with Outside Screw and Yoke
3. Kennedy Standard Double Disc Gate Valve with Non-rising Stem
4. Kennedy Standard Double Disc Gate Valve with Outside Screw and Yoke

The large Kennedy valve line includes iron-body and bronze gate, globe, angle and check valves for steam pressures up to 300 lb. and water pressures up to 600 lb. Catalog 63 describing all the Kennedy valve types in detail, together with Kennedy Pipe Fittings and Fire Hydrants, will be sent on request.

KENNEDY

VALVES • PIPE FITTINGS • FIRE HYDRANTS

THE KENNEDY VALVE MFG. CO. • ELMIRA, N.Y.

⟦ PUMP TIPS FROM ALLIS-CHALMERS—ONE IN A SERIES ⟧

How to make PACKING Last Longer . . .

The *kind* of packing and *how* you use it have a lot to do with maintaining peak pumping efficiency. Here, at left, is a step-by-step outline of the correct way to install pump packing — saving you vital man-hours and money as well.

MOST PACKING TROUBLE traces back to *lack of "know-how"* in caring for stuffing boxes. This is wasteful — time and money-wise — especially since *correct* packing procedure is so simple for maintenance men to understand and practise.

Another class of trouble traces to misalignment of pump and motor. For when shaft is deflected, sleeve is apt to wobble — greatly accelerating packing wear. To eliminate this problem, A-C engineers developed, for many applications, the "Electrifugal" pump — in which both motor and impeller are mounted on *one* shaft, in *one* frame. This means fewer parts, fewer bolted connections — no chance for misalignment.

Regardless of type of pumps you use, here is an outline of correct packing procedure — plus a few tips on what to look for when trouble *does* arise . . .

▸Make certain packing is suitable for service it must perform . . . that it's the right size and made of the right materials. Be cautious of so-called "all-purpose" packings. If in doubt, check with your pump manufacturer.

▸Don't force in new packing against the old. It's apt to displace lantern ring and plug sealing liquid opening. First remove *all* old packing; clean stuffing box thoroughly; then insert new packing.

▸Put each ring of packing in separately, seating it firmly before adding the next. Stagger adjacent rings so that joints are at 180° angle to each other. If lantern rings are used, be careful that sealing liquid openings aren't blocked as new rings are installed.

▸After required number of rings have been inserted, tighten gland nuts. Gland should be taken up evenly to *finger-tightness*. If compressed too tightly, packing will burn out or sleeves become scored.

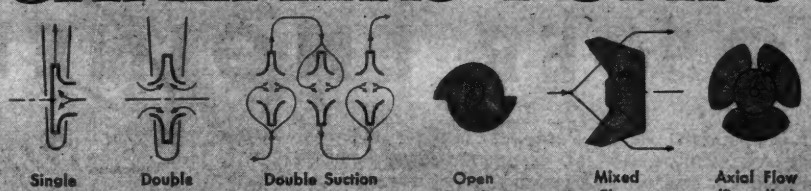
▸Finally, until shaft turns over freely, operate pump for about 1-minute intervals — permitting packing to cool. Then put it into continuous operation.

▸What to check for if packing wears too quickly — (1) Check shaft sleeves. If badly scored they grind down packing rapidly; (2) Check position of lantern ring. It may be displaced; (3) If water seal piping is used, check liquid. If it contains grit a separate source of sealing liquid should be obtained.

▸Send for your *free* copy of Allis-Chalmers' "Handbook for Wartime Care of Centrifugal Pumps". It's the basic, easy-to-understand guide to efficient centrifugal pump maintenance. Contains *no* advertising; applies to *all* makes. ALLIS-CHALMERS, MILWAUKEE 1, WIS. A 1754

ALLIS-CHALMERS PUMPS

Allis-Chalmers builds all types and variations of pumps shown at right. Capacities from 10 to 150,000 gpm—heads to 2500 lbs.

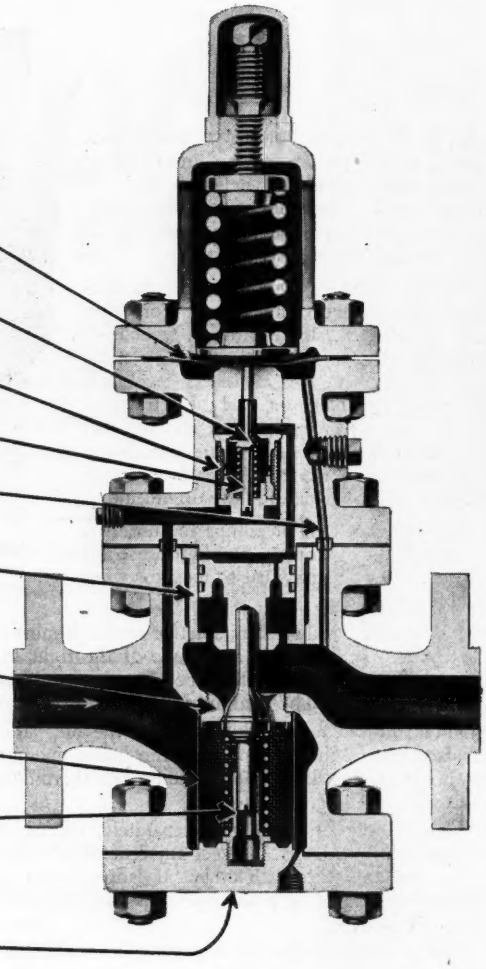


FOSTER REGULATION ENGINEERING

Saves Maintenance Time

for example:

1. Diaphragm unit can be removed without disturbing rest of valve
2. Auxiliary valve is small—easily ground
3. Entire auxiliary valve unit protected by strainer
4. Auxiliary units interchangeable for all sizes from ½" to 4"; 4½" to 10"
5. All ports internal—protected against damage
6. Cylinder liner replaceable
7. Main valve seat ring replaceable
8. Main valve protected by strainer
9. Lower guide bushing replaceable
10. Major overhaul, when necessary, without breaking the line



Foster Type G2S Pilot Operated Reducing Valve for Steam Service

Foster Regulation Engineering, built into each valve, is your assurance of years of accurate trouble free operation.

★ BUY MORE BONDS ★

FOSTER ENGINEERING Company

PRESSURE REGULATORS...RELIEF AND BACK PRESSURE VALVES...AUTOMATIC STOP AND CHECK VALVES...ALTITUDE VALVES...DAMPER REGULATORS...FAN ENGINE REGULATORS...PUMP GOVERNORS...TEMPERATURE REGULATORS...LIQUID LEVEL CONTROLLERS...FLOAT AND LEVER BALANCED VALVES...NON-RETURN AND TRIPLE DUTY VALVES...VACUUM REGULATORS OR BREAKERS...SIGHT FLOW BOXES...STRAINERS...SAFETY VALVES...SIRENS

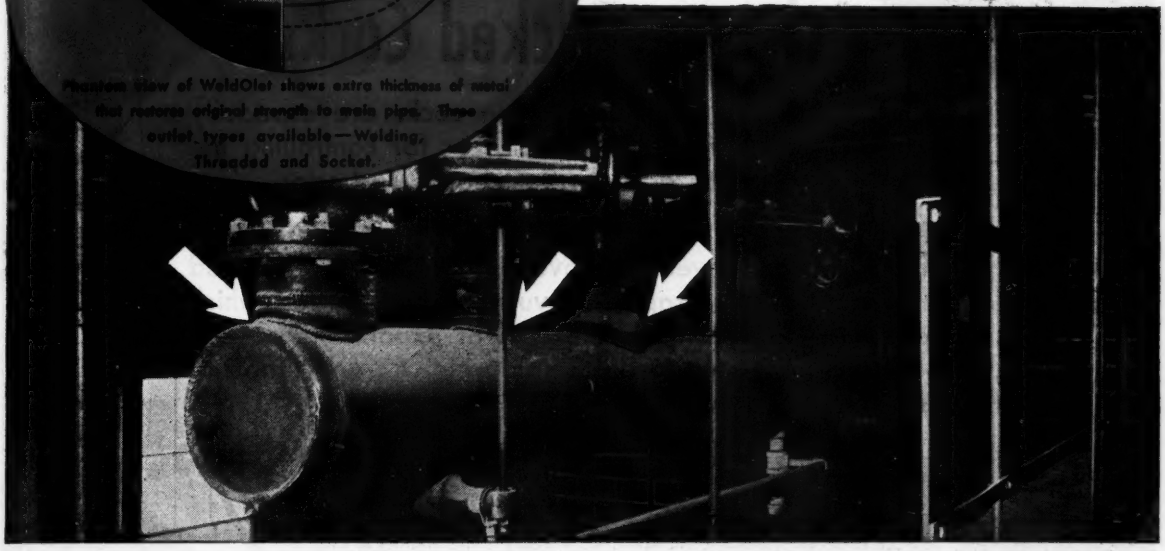
111 MONROE STREET • NEWARK 1, N. J.

9-FE-4

Get maximum Strength where needed

by WeldOlet branch pipe method

Phantom view of WeldOlet shows extra thickness of metal that restores original strength to main pipe. Three outlet types available—Welding, Threaded and Socket.



● When pressures go up you have no difficulty maintaining a factor of safety by the WeldOlet method at least equal to that of the pipe itself.

The extra thickness and strength of the forged WeldOlet fitting will more than take care of the concentration of stress, sometimes as high as 2½ times normal stress, which is present where a branch and main come together. As a result WeldOlet branch outlets resist bending and no reinforcing or bracing is necessary. In addition the flared end of the fitting increases the efficiency of the flow materially. The result is a branch outlet by the WeldOlet method that combines highest strength with maximum flow efficiency.

Size to size and reducing sizes are available in outlets from ¼" to 12" in diameter. Ask for Catalog WT31 for full information on the WeldOlet method and data on types and sizes.

Forged Fittings Division • **BONNEY FORGE & TOOL WORKS** • ***639 N. Meadow St., Allentown, Pa.***

WELDOLETS
TRADE MARK REG. U. S. PAT. OFF.
PAT. IN U. S. & FOREIGN COUNTRIES
WELDING OUTLET - THREADED OUTLET - SOCKET OUTLET
For Welded Branch Pipe Outlets

Fairbanks

Asbestos Packed Cocks

These extra-heavy vulcanized iron cocks are especially efficient for boiler blow-off service or for controlling the flow of acids which do not affect iron or asbestos.

The plug has a rectangular portway and is rust-proof. The V-shaped, dovetail grooves inside body are packed with long-fibred, graphited, vulcanized asbestos which compensates for any differentials of expansion between body and plug. Write for Catalog No. 42 and name of our nearest distributor.

THE FAIRBANKS COMPANY

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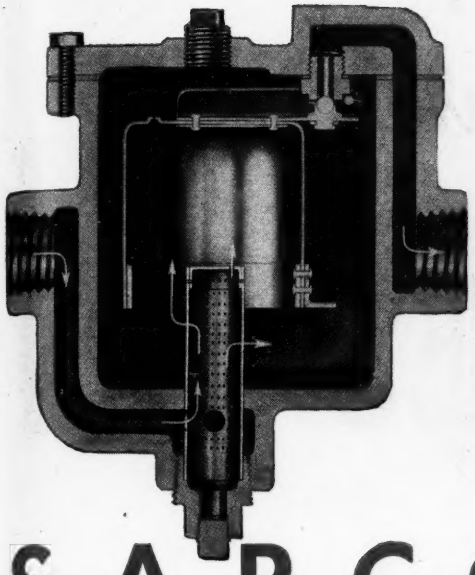

SARCO

BUCKET STEAM TRAPS *Everywhere*

On heavy heat using equipment such as presses, vulcanizers and supply lines that have very heavy loads one minute—and little or none the next, this trap is preferred.

It can be piped "straight-thru"; all mechanism is integral with the cover and is protected by a Sarco strainer *inside* the trap. It is made in standard sizes for pressures up to 250 lbs. and in forged steel types up to 900 lbs. Ask for Catalog No. 350.

BUT ONE TRAP IS NOT ENOUGH

Each of the different types of Sarco traps has a separate function. They are not interchangeable.

All save steam. The Sarco man near you knows all types and can fit the right trap to your job. His unbiased advice is yours for the asking.

Why not ask the man who knows all types and their application when you change over—the Sarco representative near you?

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SARCO CANADA, LTD., 85 Richmond St. W., Toronto, Ont.

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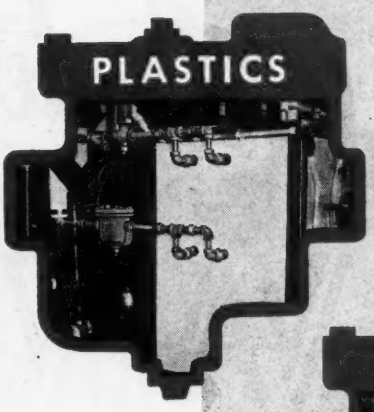
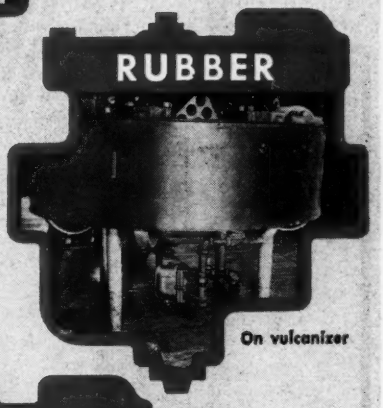
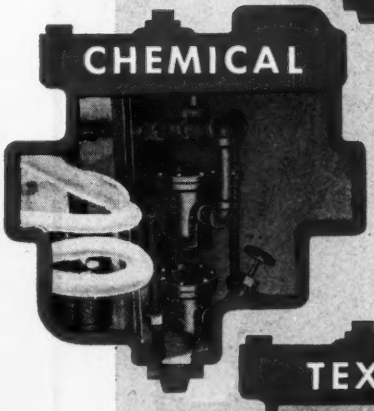


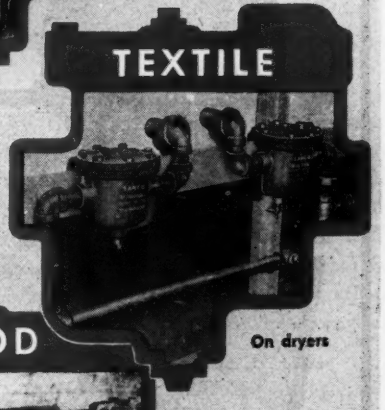
In plastics and plating plant



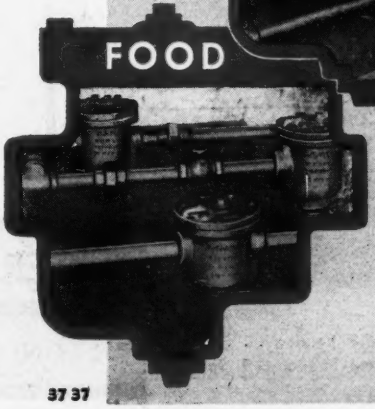
On vulcanizer



On condenser coils



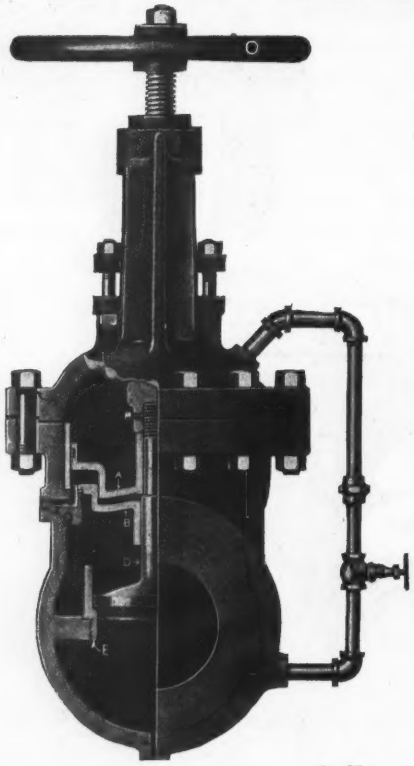
On dryers

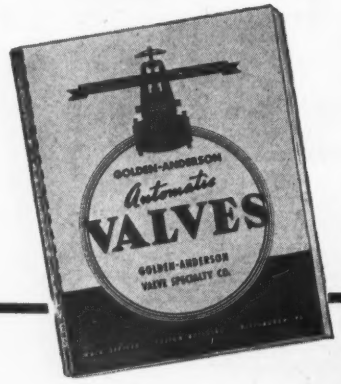


On smoke house coils

37 37

Golden Anderson SPECIALTY VALVES





Write today for this catalog . . . describes the complete line of G-A Specialty Valves.

Here is instantaneous automatic protection against runaway engines and turbines

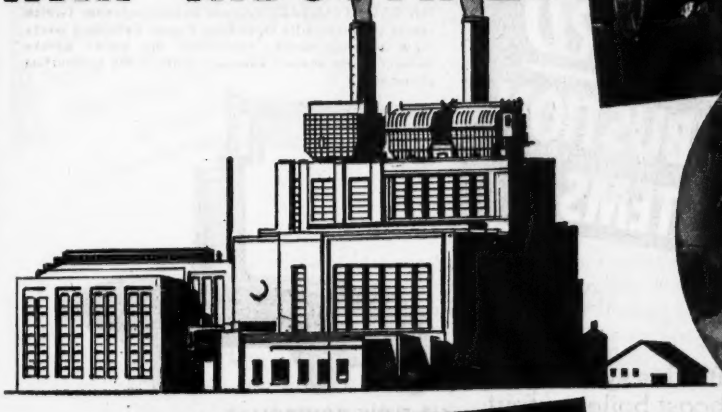
• **The Golden-Anderson Throttle and Emergency Stop Valve shown here offers positive protection against runaway engines and turbines. It works instantly . . . mechanically, electrically, by hand or remote control. No unit can exceed safe operating speed when equipped with this unit.**

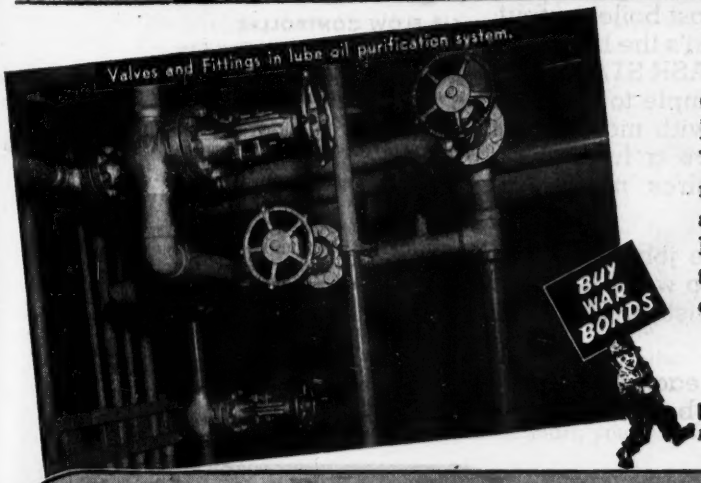
The valve is supplied in angle and globe patterns from 2½" to 16" sizes. Valve trim may be bronze, monel, stainless steel or Gallavoy, according to pressure and temperature conditions. Seat rings and disc may be stellited.

GOLDEN-ANDERSON VALVE SPECIALTY CO.

FULTON BLDG. • • • PITTSBURGH, PA.

Uninterrupted
POWER
for
WAR INDUSTRIES





● **SAFE and SURE control of vapors and liquids in steam generating plants serving our War Industries is dependent on piping materials having an inherent "plus" of strength and toughness. *Drop Forged Steel* Valves, Fittings, and Flanges made by Vogt continue to play a vital part in the smooth, efficient operations of America's leading power plants.**

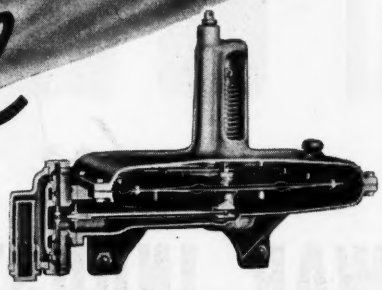
Catalog F-8 is the *drop forged steel* Valve and Fittings Blue Book.

HENRY VOGT MACHINE CO., Louisville 10, Kentucky
Branch offices: **New York, Philadelphia, Cleveland, Chicago, Dallas.**

Vogt DROP FORGED STEEL **VALVES, FITTINGS & FLANGES**

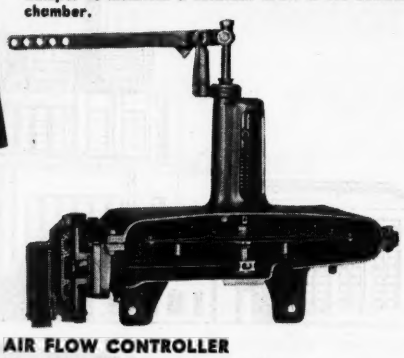
To maintain a FUEL SAVING PROGRAM and easily produce sufficient Steam

INSTALL CASH STANDARD AUTOMATIC COMBUSTION CONTROL SYSTEMS



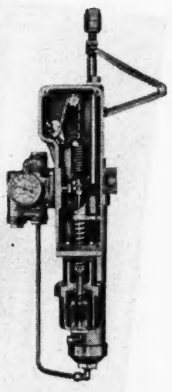
FURNACE DRAFT CONTROLLER

This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from overfire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber.



AIR FLOW CONTROLLER

This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.



FUEL FEED CONTROLLER

This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion — hence, money saving.

★ Your same boiler, equipped with this system, will use less coal, oil, or gas and you boost boiler output. You get more and yet cut costs. That's the beauty of equipping your boiler room with CASH STANDARD Automatic Combustion Control—simple to do—and it's greater economy all the way with more steam from less fuel. You really do have a fuel-saving program — and your boiler requires much less attendance time.

The three units shown here do the job — together they give you Correct Fuel Feed (no waste)—Proper Air Supply (fuel savings) and Constant Over-Fire Draft (undue stack loss prevented).

There are numerous variations of each unit—combinations are easily arranged to best serve you.

Write today for Bulletin No. 300.

A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD CONTROLS . . VALVES

"When bigger stub ends are built"...

• *As you know, Lapped-joint Stub Ends are standardized only in pipe sizes through 24 inches. In this range thousands are used, but it's only on rare occasions that a real whopper like this one is needed. It's a seamless carbon-moly forging nearly seven feet in outside diameter and about two feet long with 1½ inch wall thickness.*

Obviously, we aren't soliciting orders for 84 inch O.D. Lapped-joint Stub Ends. However, when "specials" of this kind are needed, it's a good bet that the job will be turned over to Taylor Forge.

Yes, for many years industry has considered Taylor Forge headquarters for those forging requirements that call for *unusual* knowledge of the behavior of hot metal under pressure and impact.

And isn't it true that this *unusual* "know-how" and facilities also make Taylor Forge headquarters for *unusual value* in your standard requirements for welding fittings?

You can be sure that it does, and if you want further confirmation you can find it in the features of WeldELLS listed opposite.

You will find features that are not combined in any other welding fittings . . . extra reinforcement where stresses are greatest . . . ample tangents . . . extremely accurate dimensions . . . permanent identifications . . . precision quarter marked ends. In short, you will find that

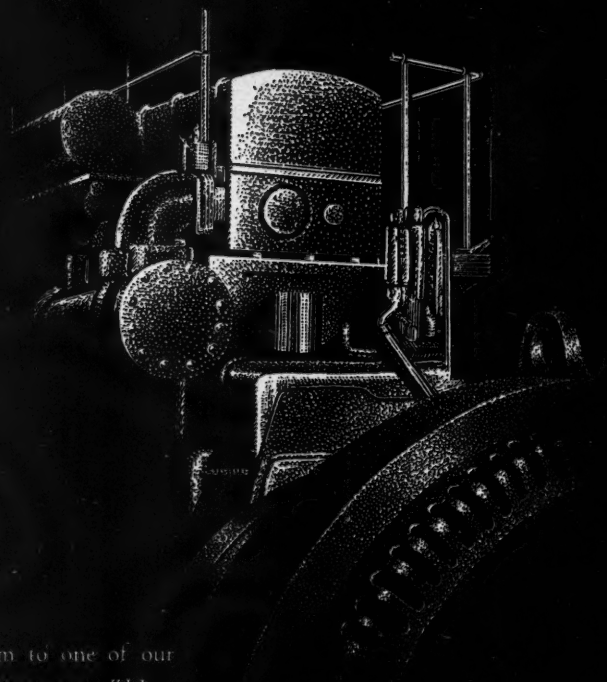
WeldELLS alone combine these features:

- **Seamless** — greater strength and uniformity.
- **Tangents**—keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends**—simplify layout and help insure accuracy.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World** — insures complete service and undivided responsibility.

WeldELLS have everything

TAYLOR FORGE & PIPE WORKS, General Offices & Works: Chicago, P.O. Box 485
New York Office: 50 Church Street • Philadelphia Office: Broad Street Station Bldg.

EXAMPLE OF *Service*:



A large company put this problem to one of our Cities Service Diesel Lubrication Engineers: "How can we reduce Diesel breakdowns that are seriously interfering with production?" . . . Our engineer studied the facts and recommended a special Cities Service Diesel lubricant. In 38 months since, Diesel efficiency has been steadily maintained, with engine overhauls reduced by the amazing figure of 30%.

More and more, it's service that counts . . .

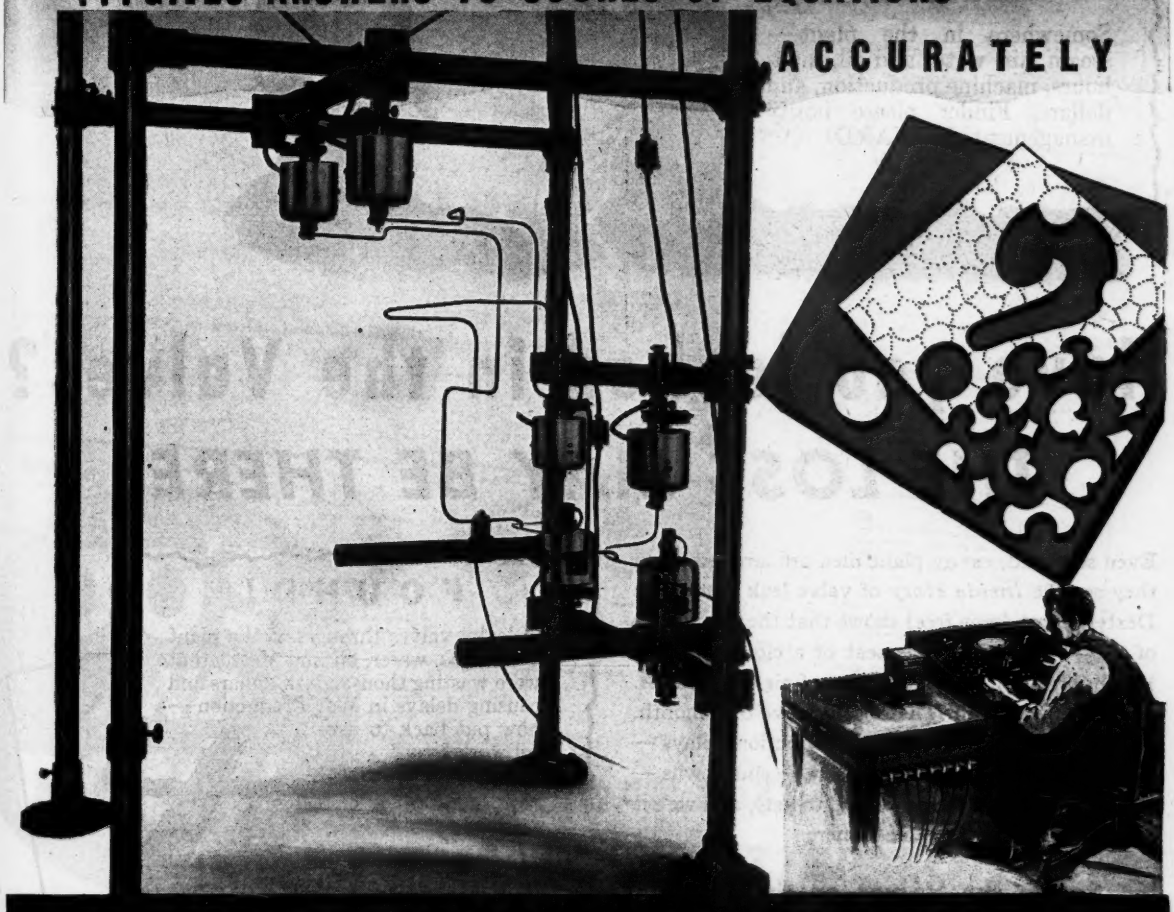
and *Cities Service* means *good service!*

CITIES SERVICE OILS — ONCE-ALWAYS

CITIES SERVICE OIL COMPANY

ARKANSAS FUEL OIL COMPANY

DETERMINING MOMENTS AND FORCES ELECTRICALLY ...GIVES ANSWERS TO SCORES OF EQUATIONS ACCURATELY



KELLOGG PIPING ENGINEERS CAN SUPPLY ACCURATE ANSWERS TO AS MANY AS 72 SIMULTANEOUS EQUATIONS—COVERING UP TO 12 POINTS OF FIXATION, WITH THIS APPARATUS!

The super-sensitive instruments which make this possible were designed and are used exclusively in the Kellogg Engineering Department for the sole benefit of Kellogg clients. By their use the most complicated design problems of high pressure, high temperature piping systems are solved accurately and quickly—an exact scientific analysis of the end reactions is arrived at.

There is no guess work, no possibility of error or delay in figuring, when these sensitive Kellogg instruments are used. They reduce figuring time, assure absolutely accurate results and thus save our clients time and money by giving them mechanically and scientifically correct piping systems for their individual needs as well as often substantially reducing the quantity of vital piping material

KELLOGG **THE M. W. KELLOGG COMPANY**
Jersey City, N. J. • 225 Broadway, New York 7, N.Y.
Representatives:
LOS ANGELES: 609 SOUTH GRAND • TULSA: PHILTOWER BLDG.

"Masterflex" Prefabricated Piping Systems • "Masterweld" pressure vessels for Power, Refinery and Chemical Industries. Heat Exchangers. Pyrolytic and Catalytic Cracking Units, Hydroforming, Reforming, Dehydrogenation, Alkylation, Desulphurization. Thermal and Catalytic Polymerization Units • JUIK Processes for Lubricating Oil Plants. Plastic Refractories • Radial Brick Chimneys.

LOST!

Somewhere in the plant — steam, air, water and oil, man-hours, machine production, and dollars. Finder please notify management. REWARD

Have you looked in the Valves?

THE LOSS MAY BE THERE!

Even seasoned, canny plant men are amazed when they see the *inside story* of valve leak costs. The Dexter Chart (sent free) shows that the equivalent of a 1/32" hole across the seat of a closed valve in 100 lb. lines will lose 69,552 lbs. of air or 3,175 lbs. of steam per month. That's *one* valve *one* month. Now add the other valves — production delays — process spoilage — costly repairs — shutdowns — and new valves (which are hard to get), and we see why more and more valve owners

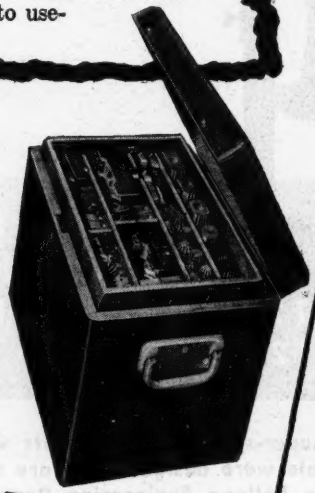
Reseat the Valves on the Line The DEXTER Way

One man can reseat any globe, gate or pump valve without removing it from the Line. He merely removes the bonnet, stem and disc and inserts the Dexter Machine. Seats and Disc are quickly and easily reseated, with all wire grooves and score marks removed, and the valve reassembled actually better than new! No new parts — no slow and costly breaking-out of old valve — no long delays.

Write today for the Dexter Bulletin — or better, tell us about your worst leaky valve and let us recommend the machine and quote its cost. Remember, Dexter Valve Reseating Equipment, by stopping costly valve leaks, usually pays for itself in a few months' time. Don't delay — write today.

FOUND!

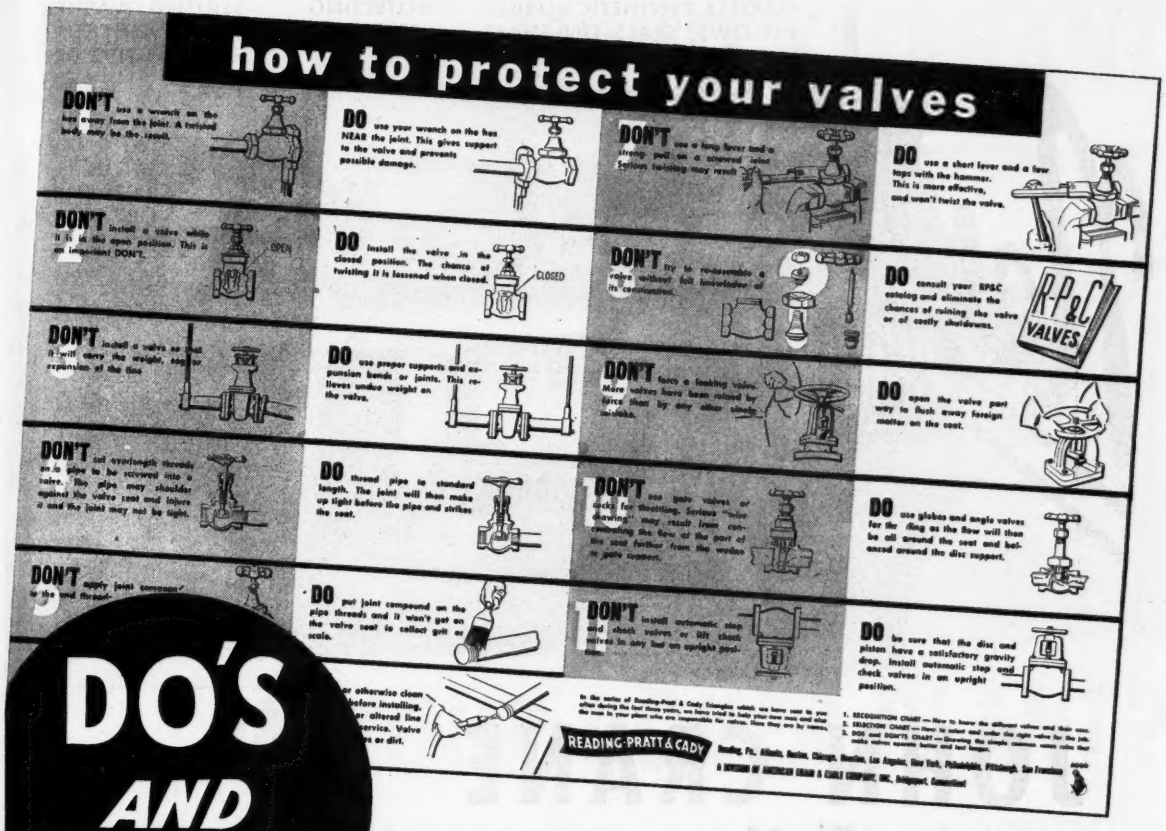
in leaky valves throughout the plant — air, gas, water, oil and steam that were wasting thousands of dollars and causing delays in War Production — now put back to useful work by



FOR GLOBE, GATE AND PUMP VALVES

DEXTER VALVE RESEATING EQUIPMENT

THE LEAVITT MACHINE COMPANY
ORANGE, MASSACHUSETTS


how to protect your valves
DON'T use a wrench on the hex away from the joint. A twisted body may be the result.
DO use your wrench on the hex NEAR the joint. This gives support to the valve and prevents possible damage.
DON'T use a long lever and a strong pull on a screwed joint. Serious twisting may result.
DO use a short lever and a few taps with the hammer. This is more effective, and won't twist the valve.
DON'T install a valve while it is in the open position. This is an important DON'T.
OPEN
DO install the valve in the closed position. The chance of twisting it is lessened when closed.
CLOSED
DON'T try to re-assemble a valve without full knowledge of its construction.
DO consult your RP&C catalog and eliminate the chances of ruining the valve or of costly shutdowns.
R-P&C VALVES
DON'T install a valve so that it will carry the weight, regular expansion of the line
DO use proper supports and expansion bends or joints. This relieves undue weight on the valve.
DON'T force a leaking valve. More valves have been ruined by force than by any other single mistake.
DO open the valve part way to flush away foreign matter on the seat.
DON'T cut enough threads on a pipe to be screwed into a valve. The pipe may shoulder against the valve seat and injure it and the joint may not be tight.
DO thread pipe to standard length. The joint will then make up tight before the pipe end strikes the seat.
DON'T use gate valves or cocks for throttling. Serious "wire drawing" may result from confining the flow of the part of the seat further from the wedge or gate support.
DO use globes and angle valves for the flow as the flow will then be all around the seat and balanced around the disc support.
DON'T apply joint compound to the end threads
DO put joint compound on the pipe threads and it won't get on the valve seat to collect grit or scale.
DON'T install automatic stop and check valves or lift check valves in any but an upright position.
DO be sure that the disc and piston have a satisfactory gravity drop. Install automatic stop and check valves in an upright position.
or otherwise clean before installing. or altered line service. Valve or dirt.
READING-PRATT & CADY
Reading, Pa. Atlanta, Boston, Chicago, Houston, Los Angeles, New York, Philadelphia, Pittsburgh, San Francisco
A DIVISION OF AMERICAN CHAIN & CABLE COMPANY, INC., Bridgeport, Connecticut

DO'S AND DON'TS ...TO MAKE YOUR VALVES SERVE YOU *BETTER-LONGER*

This is the third of the series of charts developed by Reading-Pratt & Cady as a service to the valve users of the nation. Like the other two—How To Know Valves and How To Select Valves—this one, How To Protect Your Valves, will serve as a reminder to experienced men and as invaluable information to new men in industry. It tells in pictures and simple, non-technical language how to avoid the mistakes that shorten the life of valves—how to get maximum service from them.

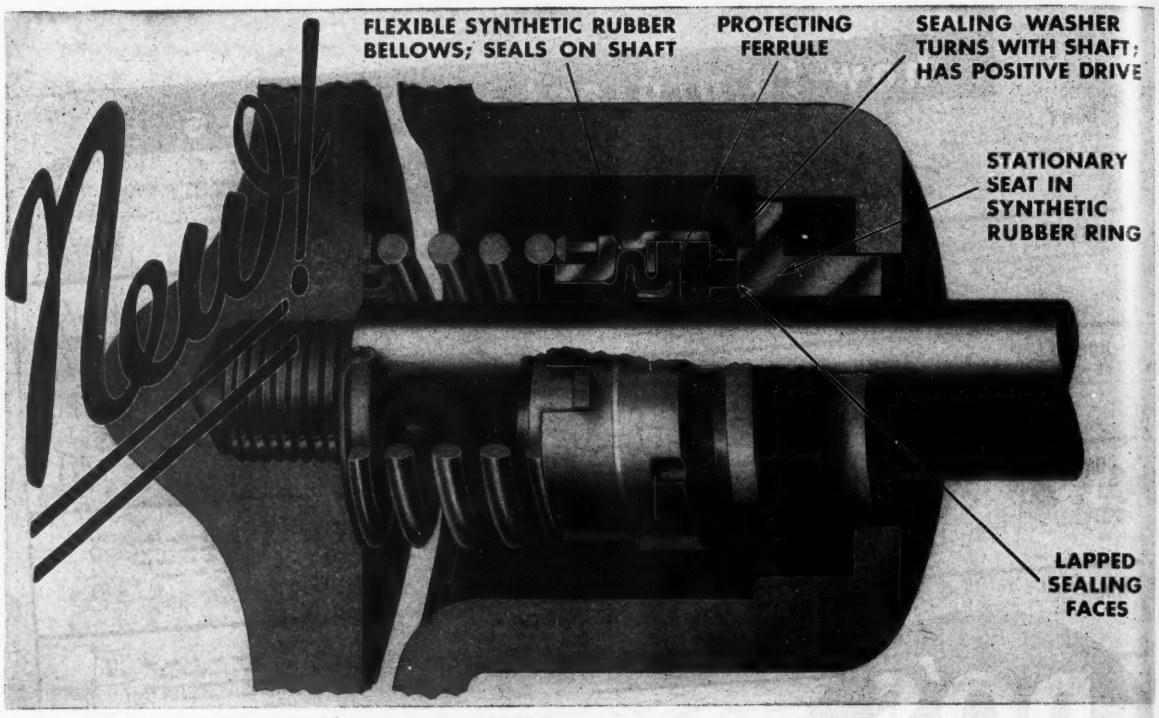
For copies of this chart, address our offices in Reading, Pennsylvania. There's no charge, of course.

READING-PRATT & CADY

MANUFACTURERS OF
READING CAST STEEL VALVES AND FITTINGS • PRATT & CADY BRASS AND IRON VALVES
D'ESTE VALVE AND ENGINEERING SPECIALTIES

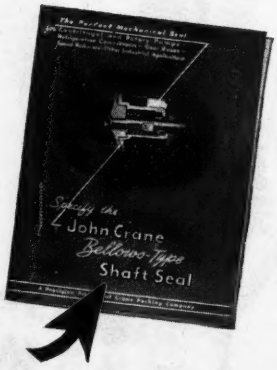
Reading, Pa., Atlanta, Boston, Chicago, Denver, Houston, Los Angeles, New York, Philadelphia, Pittsburgh, San Francisco

A DIVISION OF AMERICAN CHAIN & CABLE COMPANY, Inc., BRIDGEPORT • CONNECTICUT


New!
FLEXIBLE SYNTHETIC RUBBER BELLOWS; SEALS ON SHAFT
PROTECTING FERRULE
SEALING WASHER TURNS WITH SHAFT; HAS POSITIVE DRIVE
STATIONARY SEAT IN SYNTHETIC RUBBER RING
LAPPED SEALING FACES

JOHN CRANE *Bellows-Type* SHAFT SEAL

- **The Perfect Mechanical Seal** for Centrifugal Pumps—Refrigeration Compressors—Speed Reducers—Rotary Pumps—Agitator Shafts—Many Other Rotary Sealing Applications.
- **Eliminates** Leakage, Gland Adjustment and Shaft Wear—Reduces Friction—Saves Power —Seals Perfectly at High Speeds and High Pressures.
- **Exclusive Features** —
  1. **Flexible Synthetic Rubber Bellows Head** slides freely—provides automatic compensation for washer wear, shaft vibration and end play through wide range.
  2. **Protecting Ferrule** prevents Bellows Head from touching shaft. **Assures free sliding** at all times.
  3. Sealing washer has **positive drive** through metal parts.
  4. **A Complete Unit, ready for use.** Sealing faces factory-lapped.
- This Precision-Built Shaft Seal is already thoroughly proven on many exacting services.

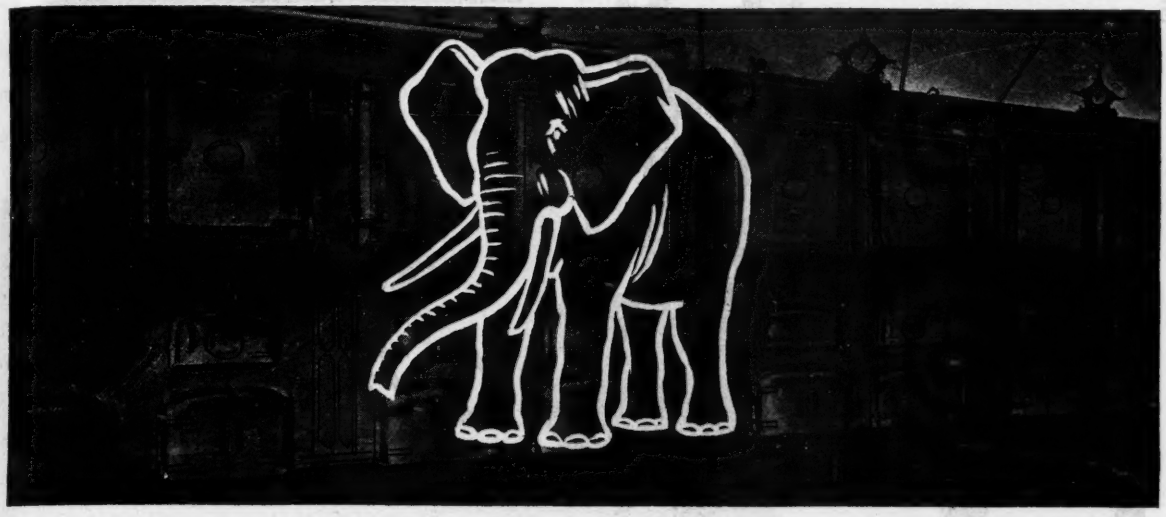


Design and Development Engineers — Send for Illustrated Bulletin

CRANE PACKING COMPANY

1812 CUYLER AVENUE • CHICAGO 13, ILLINOIS

ARE YOU NURSING A WHITE ELEPHANT



IN YOUR BOILER PLANT?

MODERNIZE HEAT AND POWER EQUIPMENT WITH DEPENDABLE, EFFICIENT TODD BURNERS

POST-WAR competition is going to be tough—no doubt about that. The manufacturer whose operating costs are low will have a head start. An inefficient boiler plant can inflate your whole price structure. Start paring *your* costs now, by modernizing your heat and power plant immediately.

Owners and operators of plants of all types in many states have taken this forward looking step, by installing TODD oil or gas burners. *Many report fuel savings as high as 10%, and over 10% increases in heat and power output!*

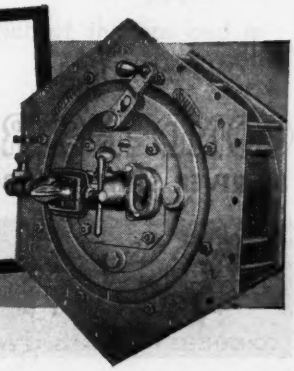
TODD engineers will survey your boiler plant without obligation and recommend the most effective set-up for your operations. Continuing research in combustion engineering has made TODD the leader in designing and manufacturing liquid and gaseous fuel-firing equipment. This insures TODD users of the highest efficiency and lowest operating and maintenance charges.

Take advantage of TODD leadership *to reduce the cost of producing a pound of steam* in your plant. Call on TODD engineers for a consultation.

ARMY E NAVY

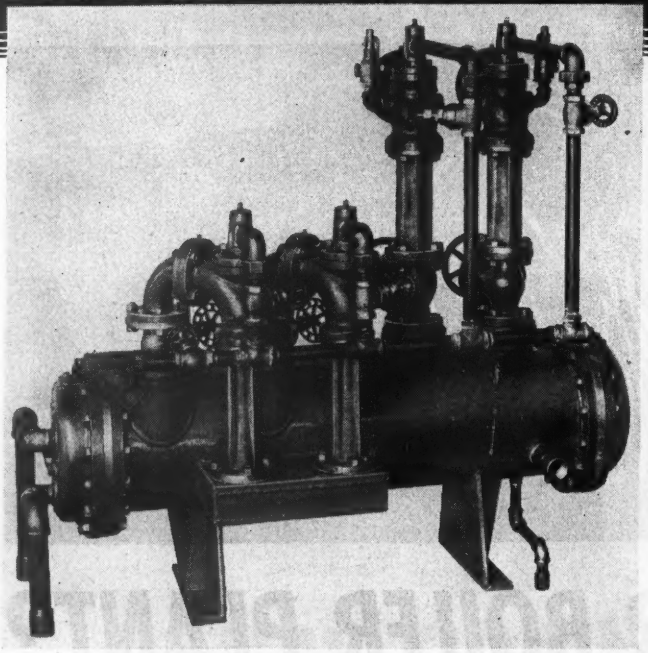
COMBUSTION EQUIPMENT DIVISION
TODD SHIPYARDS CORPORATION
601 West 26th Street, New York 1, N. Y.

NEW YORK ★ BROOKLYN ★ HOBOKEN ★ BARBER, N. J. ★ SO. PORTLAND, ME.
GALVESTON ★ HOUSTON ★ MOBILE ★ NEW ORLEANS ★ LOS ANGELES
SAN FRANCISCO ★ SEATTLE ★ TACOMA ★ BUENOS AIRES ★ LONDON



ON THE FIRING LINE OF AMERICA'S WAR FRONT

HIGH VACUUM *at low cost*



Conseco Steam Jet Two-stage Twin-element Air Ejector. Permits continuous operation during servicing of elements.

CONSECO *Steam Jet*

Twin Element

AIR EJECTORS

For

CONDENSERS
EVAPORATORS
PRIMING PUMPS
EVACUATORS
PROCESS INDUSTRIES
VACUUM COOLING UNITS
DRAINS COLLECTING UNITS for MARINE HEATING SYSTEMS

Conseco Steam Jet Air Ejectors are designed to meet individual requirements, whether for new applications or for replacement of reciprocating vacuum pumps to secure lower operating and maintenance costs. Models of one or more stages are available.

The two-stage unit illustrated is recommended for most installations. It has twin elements with isolating valves and surface type inter and after condensers. The unit operates at high efficiency with only one set of elements during normal operation, and has a good capacity for starting up. Isolating valves permit removal of elements for cleaning or repair during operation. Inter and after condensers return all heat in nozzle steam to condensate from main condenser. Drains are delivered to main condenser hotwell for deaeration and collection in feed-water cycle.

Our wide experience in servicing, repairing and replacing all types of air ejectors gives us a practical background for designing an efficient unit for your own requirements.

SERVICE — A highly skilled, specially equipped service organization, ready for immediate action anywhere on the continent, backed by engineering and manufacturing facilities producing over 3,000,000 sq. ft. of heat exchangers annually.

CONDENSER SERVICE & ENGINEERING CO., INC.

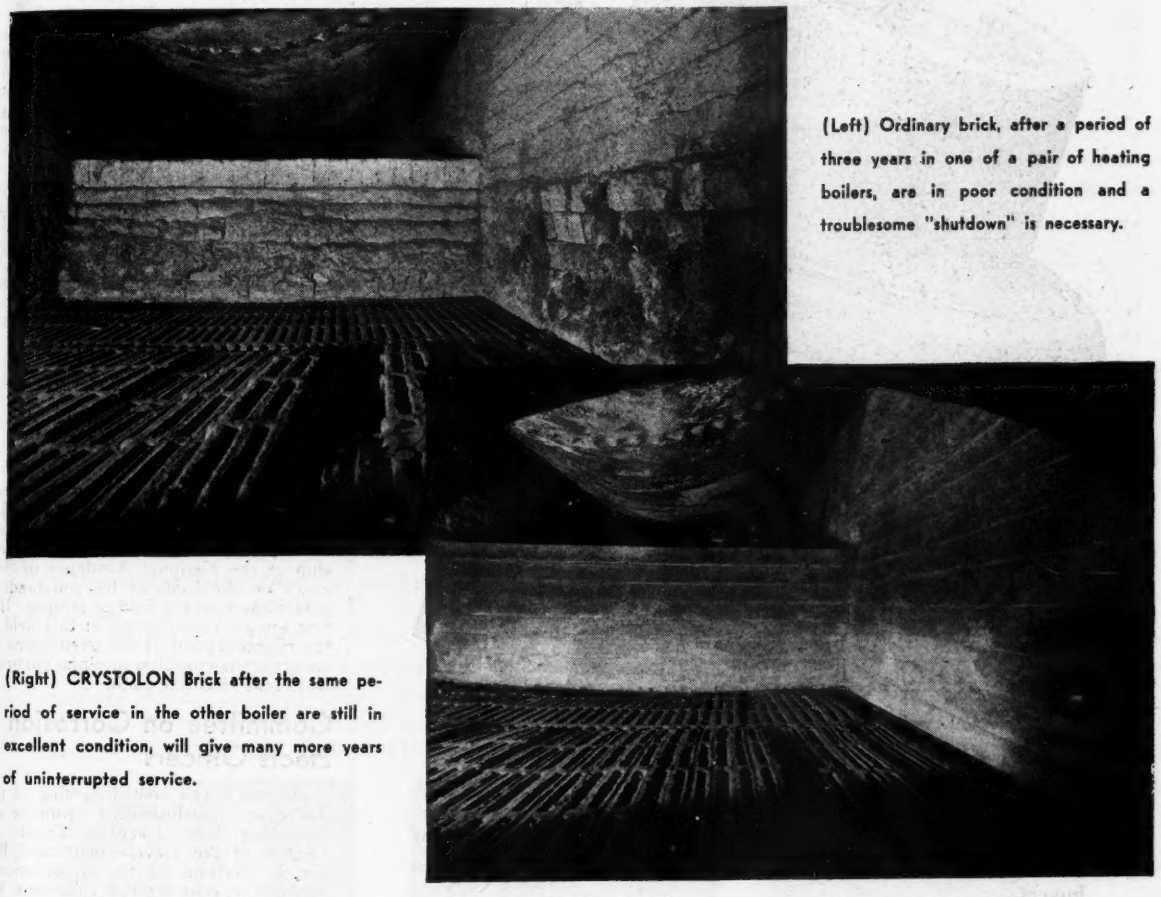
83 RIVER STREET, HOBOKEN, N. J. **Phone HOboken 3-4425** **After 6 P.M. or Sundays HOboken 3-4428**

CONDENSERS • LOW PRESSURE EVAPORATORS • AIR EJECTORS • HEAT EXCHANGERS • PUMPS

TUBE CLEANING GUNS AND PLUGS
AIR AND EROSION ELIMINATORS
BEVEL GEAR UNIVERSAL JOINTS
STRAINERS, GREASE EXTRACTORS
WIZARD INJECTORS, FILTERS

For Bricks that stand the gaff . . .
order CRYSTOLON

In many installations CRYSTOLON Brick pay for themselves in one year. These silicon carbide brick made by Norton Company are made to stand up under severe operating conditions in stoker-fired furnaces, generators of water gas sets and combustion chambers of high temperature furnaces.



(Left) Ordinary brick, after a period of three years in one of a pair of heating boilers, are in poor condition and a troublesome "shutdown" is necessary.

(Right) CRYSTOLON Brick after the same period of service in the other boiler are still in excellent condition, will give many more years of uninterrupted service.

CRYSTOLON Brick are particularly resistant to high temperatures and to the chemical action of molten slag. Because of exceptional density they resist the penetration of molten ash. Ruggedness enables CRYSTOLON Brick to resist the abrasive action of ash and the motion of the fire bed in stoker-fired furnaces.

NORTON COMPANY — Worcester 6, Mass.

Norton Longer Lasting Refractories

DART UNIONS

Cost Less Per Year

The union that costs least is the one that gives most in service. That's why Darts are the choice of veteran buyers.

Built with two bronze seats, which are ground to a true ball joint, they become in use practically one-piece units. Yet, they dismember in a jiffy—unscarred, and ready again for service wherever a leak-proof coupling is needed.

Bodies and nuts are of high-test air-refined malleable iron—practically unbreakable.

Next time you change piping, change to Darts. Your supplier will be glad to show you what a difference there is.

DART UNIONS — DART UNIONS LIVE LONGER

E. M. DART MFG. CO., Providence, R. I.

NEWS FROM THE FIELD

SPAA Reports 100 Research Projects on Smoke Elimination

AT THE RECENT annual meeting of the Smoke Prevention Association of America, Inc., held in Detroit, J. E. Tobey reported that upwards of 100 research projects will be pursued under the following major divisions: Residential Heating; Industrial and Commercial Steam Uses; Industrial Non-Steam and Special Uses; Coal, Combustion, and Ash; Carbonization; Gasification; Preparation, Transportation and Handling; Railroad Fuel and Locomotive Development; Chemicals from Coal; Mining Problems; Technical Service. Nearly every one of these investigations will in some manner be related to smoke elimination. Although the program is not directed entirely toward smoke elimination, it is directed toward the improvement of combustion equipment, and this will in effect accomplish that purpose.

Dr. Edward U. Condon Elected to National Academy of Sciences

DR. EDWARD U. CONDON, associate director of the Research Laboratories of Westinghouse Electric & Mfg. Co., has recently been elected to membership in the National Academy of Sciences on the basis of his outstanding contribution to the field of science. His best known contribution in this field is the interpretation of the phenomena of spontaneous emission of alpha particles from materials like radium.

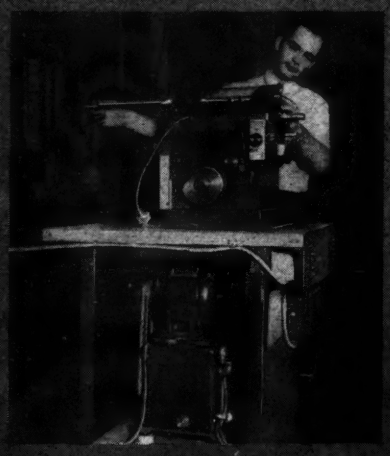
Committee on Corrosion Elects Officers

AT THE SIXTH annual meeting of the American Coordinating Committee on Corrosion held recently, Frank L. LaQue, of the Development and Research Division of the International Nickel Co., was elected Chairman for the current year. Dr. George H. Young, of the Mellon Institute of Industrial Research, was named Vice-Chairman, and George W. Seagren, also of Mellon Institute, was elected Secretary-Treasurer. The Committee headquarters are located at 4400 Fifth Avenue, Pittsburgh, Pa.

The Coordinating Committee was organized in 1938 to serve as a clearing house and coordinating agency for information on American experience and American work in progress in the field of corrosion and corrosion prevention, and to act as an agency for the exchange of corrosion information and experience with similar foreign agencies such as the corrosion committee of the British Iron and Steel Institute. It also serves as a medium through which individual workers may make contact with other investigators here and abroad in specific fields of corrosion work.

CAN'T QUIVER

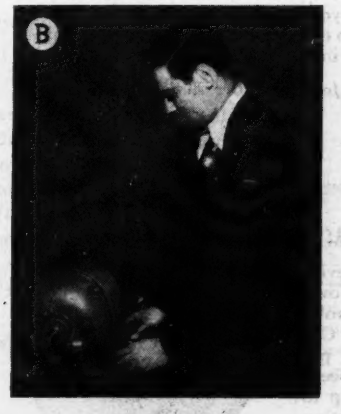
Motors driving precision machines can't quiver without affecting the work, particularly when the motor is mounted directly on the machine. The close tolerances required on so much vital war equipment have intensified the need for machines and motors that remain smooth-running, month after month, in three-shift service. Why have G-E Tri-Clad motors gone on—and stayed on—so many high-precision machines? Our test procedure for balance and vibration is an important part of the answer.

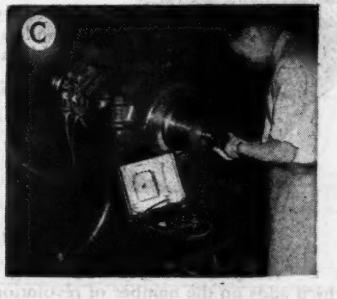


High-precision reaming machine in Waltham Watch Company plant, driven by G-E Tri-Clad motor

G.E.'s vibration tests and balancing procedure help make TRI CLAD motors smooth-running and quiet

Unmatched experience in making vibration studies, especially our work on high-speed turbines, helped us to perfect dynamic-balance techniques and devices that give assurance of smooth-running motors. Every Tri-Clad rotor is dynamically balanced, and in addition, spot-checks of assembled motors are made: (A) making an electronic dynamic-balance test on Tri-Clad rotors; (B) spot-check with G-E vibration indicator, with motors on elastic mountings; (C) portable electromagnetic tester being used on large motor. This test can also be applied to a motor installation, if desired. *General Electric Company, Schenectady 5, New York.*





GENERAL ELECTRIC

Buy all the BONDS you can—*and keep all you buy*

The "FRAHM" VIBRATING-REED HAND TACHOMETER . . .

requires no contact with the rotating element and is unique for measuring speed of totally enclosed machines and other equipment where the end of the shaft is not accessible. The only mechanism is a set of accurately tuned steel reeds which vibrate by resonance according to the speed of the machine with which the instrument is held in contact.

For hand use in servicing, installation and maintenance work; also built in types for permanent mounting. Various ranges available from 900 to 30,000 r.p.m.

Write for descriptive Bulletin 1590-P.E.

The JONES HEAVY DUTY HAND TACHOMETER

is used for indicating r.p.m. and surface speeds of all types of machinery in which the moving parts are readily accessible. Simple, rugged and reliable, it is built to maintain accuracy in hard, everyday service. Single and triple range models up to 12,000 r.p.m. supplied complete with carrying case and accessories.

Write for descriptive Bulletin 1710-P.E.

. . . The JAEGER SPEED INDICATOR

is a "vest-pocket" speed-measuring device which adds up the number of revolutions over a period of six seconds and shows the revolutions per minute without any calculations. Can also be used to measure speeds in feet per minute. Available in two models—for all speeds up to 2000 r.p.m. and for all speeds up to 10,000 r.p.m. Supplied complete with carrying case and accessories.

Write for descriptive Bulletin 1750-P.E.

JAMES G. BIDDLE CO. **1211-13 ARCH STREET PHILADELPHIA 7, PA.**

New Plant for Union Bag & Paper Corp.

CONTRACT for design and construction of a new high pressure steam plant, new power generating station and other auxiliary work in the 1944-45 expansion program of the Union Bag and Paper Corp. at Savannah, Ga., has been awarded to The Rust Engineering Co., of Pittsburgh, Pa., and Birmingham, Ala. The project, valued at approximately $1,500,000, will include alterations and modernizations of the paper corporation's existing steam and power generating facilities at Savannah.

Studies of Undeveloped Power Resources of Owens Gorge to Continue

ENGINEERING studies of the undeveloped power resources of Owens Gorge, in Inyo County, will be continued during the current fiscal year as a result of action by the Board of Water and Power Commissioners of the Los Angeles, California, municipal utility, in July. Expenditure of $75,000 was authorized for the purpose. The work will progress studies of most efficient locations for power plants, penstocks and surge chambers. Complete development of gorge power has been under discussion for some years.

Los Angeles Department of Water and Power Contracts for Additional Power from Boulder

THE LOS ANGELES, Calif., Department of Water and Power in July contracted for the purchase of approximately 268,252,898 kwhr of additional unused energy from the Boulder power plants during the current fiscal year, at the firm rate of 0.00124 cent per kwhr. The purchase is a cut-back from the 1,190,000 kwhr of energy contracted for by the Defense Plant Corp., released due to production curtailment at the Basic Magnesium plant in Las Vegas, Nevada. The purchase was arranged in consultations between the Department, the Southern California Edison Co., and the Secretary of the Interior. The additional power from Boulder will displace steam plant energy, and will conserve an estimated half million barrels of fuel oil, an important contribution to the current scarcity.

National Power Show

ANNOUNCEMENT has been made that the 16th National Exposition of Power and Mechanical Engineering will be held in Madison Square Garden, New York, November 27 to December 2, next. This year's event will be keyed to the effective solution of continuing war production problems, particularly those caused by sudden shifts in military needs, demanded by the ever changing scenes in Europe and Western Oceania. It will also provide informational sources for the advancement of post-war planning.

Held biennially, the National Power Show, as it is commonly known, is widely recognized as an effective institution for the development of more effective utilization of the Nation's power resources. The last Exposition, held in 1942 in the midst of war work,

WHEN BOWSER EQUIPMENT WENT TO WORK,

Regrinds Dropped from 25% to ½%

Precision gages, such as those made by Standard Gage Company, Inc., of Poughkeepsie, N. Y., and required by thousands of manufacturers in scores of industries, have tolerances as small as .00001 inch.

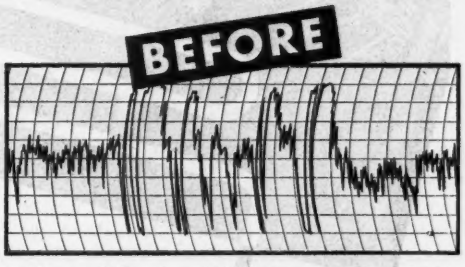
Standard Gage, in its grinding operations, works to .0001, after which the gages are lapped to the final tolerance. Abrasions, due largely to particles in the unfiltered coolant, were causing regrinds averaging 25%.

Bowser Pressure Filters were installed . . . and *regrinds dropped to less than 5/10 of 1%!* Picture that in terms of savings in time, labor and money!

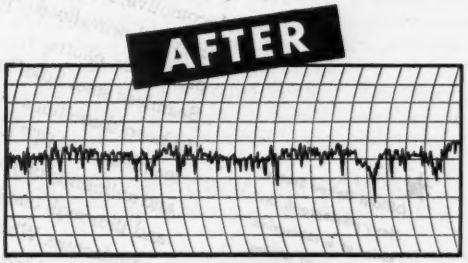
Bowser Filters are only one of the many types of Bowser equipment that are helping American manufacturers build more, faster, better—and usually with real money-saving.

In the power field, for example, there are Bowser Turbine Oil Conditioners, Force Feed Lubricators and other liquid control units. Here's a quick case-history of a Bowser Turbine Oil Conditioner in a prominent steel plant: In ten days, it lowered the acid number of the oil from .0561 to .021 (even lower than the *new* oil added when the conditioner was installed). Frequent bearing failures were stopped. Average oil temperatures were reduced 51°. Only a little make-up oil is added periodically—no batches ever dumped.

A Bowser engineer will gladly consult with you. Write today. BOWSER, INC., Fort Wayne 5, Indiana.



Surface variations (graph lines represent five-millionths of an inch) after a finish-grinding with unfiltered coolant oil prepared only 2 days previously. Scratches, scarcely visible, were deep enough to necessitate regrinding.



Same operation, same machine, with Bowser-filtered coolant that had been in use 7 days. Comparable improvements were recorded on all makes and types of grinders after Bowser Filters were installed.

Not only has Bowser's war production earned the Army-Navy E... Bowser equipment has helped earn it for scores of other companies.

BOWSER ESTABLISHED 1885

The Name That Means **Exact Control** *of Liquids*

BUY WAR BONDS

INTESTINES with Fortitude!

PTP

Seamless steel tubes are the intestines of the ship, the power plant, the oil refinery, the locomotive, and the chemical plant...delivering an ever-flowing flood of power to America's mighty production efforts.

Seamless steel tube "know-how" is vitally necessary to keep those lines going steadily. Cold drawn seamless steel PTP tubing achieves accuracy to size and uniformity of gauge through exacting control and thorough inspection at every step in manufacture. Where cost is a factor, and seamless steel tubing required, PTP tubing offers an economical and satisfactory solution to the problem.

★ Official United States Navy photograph. Interior of a submarine —a maze of piping.

PIPE & TUBE PRODUCTS
INCORPORATED
Manufacturers of Cold Drawn Seamless Steel Tubing
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proved exceedingly helpful to a wide range of new visitors, greatly expanding the service to industries in all fields.

The National Power Show is under the sponsorship of an advisory committee with Charles F. Roth, president, International Exposition Co., as manager and E. K. Stevens, associate manager of the Exposition.

Grants for Cooperative Research Made by ASHVE

AT ITS Semi-Annual Meeting in Grand Rapids, Michigan, the Committee on Research of the American Society of Heating and Ventilating Engineers, 51 Madison Avenue, New York City, made grants of nearly $10,000 for cooperative research covering 10 projects at 7 universities, according to the announcement of G. L. Tuve, Chairman.

Technical Motion Picture Now Available

A NEW sound motion picture film entitled, "Only A Gasket," is being made available to technical societies, manufacturing groups, colleges and other organizations by the Goetze Gasket & Packing Co., 17 Allen Avenue, New Brunswick, N. J. This film is a 16 mm Kodachrome with sound, and the commentary is by Lowell Thomas. It runs about 35 min and tells of the research and manufacturing facilities employed in this highly specialized business of sealing the joints in vital equipment against the effects of high temperatures, pressures, corrosion and other service conditions.

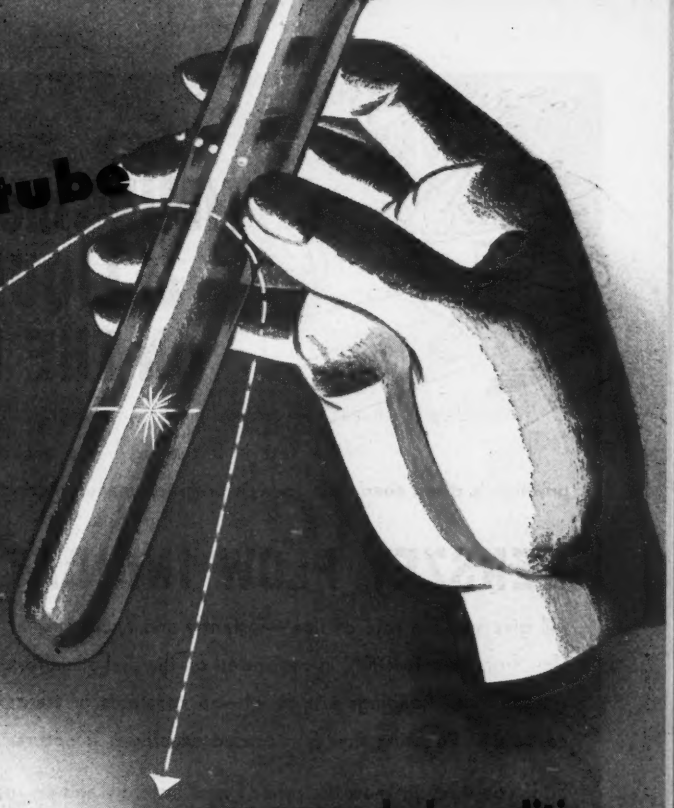
Fire Resistant Control Panels

TO MINIMIZE the possibility of fire which could put the entire electrical system of a fighting ship out of commission, the Navy Department, Bureau of Ships, has issued a directive requiring use on Navy ships of a fire-resistant, glass fiber-reinforced plastic material for panel boards on which electrical control instruments are mounted.

The new-type panel board material is a laminate built up of many layers of cloth woven of fibrous glass yarns, and impregnated and bonded with a melamine resin. It is the result of research initiated by the Navy Department before Pearl Harbor, and carried on with the co-operation of fabricators and manufacturers of electrical control equipment who had to solve many difficult design problems created by the physical properties of the new material.

In addition to being fire resistant, the fibrous glass and melamine combination has high impact strength and high resistance to the carbonizing effect of the electric arc—a condition that occurs when current jumps, or arcs, from one terminal to another across the board. Severe arcing could itself be responsible for panel board fires which, destroying the electrical system, would leave the ship out of control.

scale-free boiler tubes start in a test tube



The first step in efficient operation is a "properly conditioned boiler water." The Dearborn Service Engineer in your district knows how to get it. He can talk with you about the specific problems in connection with your local water supply.

The results of the complete laboratory findings go to our chief chemical engineer, who works out a formula to fit your conditions and recommends the amount of chemicals to be used together with suggested methods of application. This is transmitted to you direct—or through the Dearborn Service Engineer.

Testing Cabinet

A wide range of complete testing equipment is available for plants of all sizes and various requirements.

...recommended conditions are maintained by checking with this Testing Cabinet in your own plant

When recommendations are adopted by your plant, continuous control of boiler water can be maintained with the Dearborn Testing Cabinet—designed for use in your own plant to test boiler water samples.

Report blanks keep contact between us, and all control tests are under the constant direction and supervision of Dearborn's Chief Technical Engineer, whose experience covers boiler water conditions in all size steam producing plants in every state in the union.

Call for the Dearborn Service Engineer in your district to give you complete details on how to get that "properly conditioned boiler water."

DEARBORN CHEMICAL COMPANY
Dept. P, 310 S. Michigan Ave., Chicago 4, Ill.

Dearborn
TRADE MARK REGISTERED

BOILER WATER TREATMENT AND SERVICE

TIMING the FLOW of LIQUIDS ON THE RUN

How fast is it running? The answer to that problem is often needed in today's precision manufacturing.

HENSZEY FLOW INDICATORS

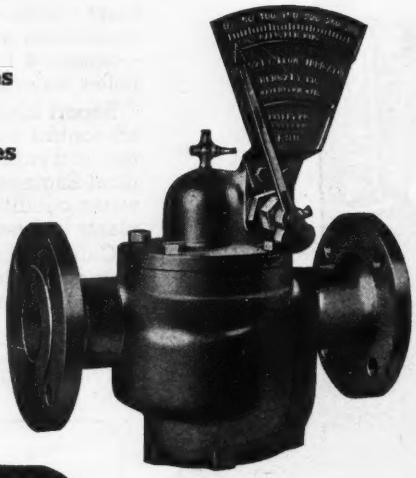
will give you the rate of flow—instantly and accurately at any time. Flow from zero to 100% is registered on the dial of uniformly spaced graduations. Readings are direct—no constants or transcribing are necessary. Pulsating flow is recorded exactly as it occurs.

So if you want to know the rate of flow instantly and accurately plan now on using the Henszey Flow Indicator. Send for full information.

HENSZEY CO., Dept. C 9, Watertown, Wis.

Satisfactorily performing in

- **Paper Mills**
- **Chemical Plants**
- **Petroleum Refineries**
- **Milk Condenseries**
- **Other War Industries**



Sizes range from 10 G.P.M. to 600 G.P.M. Pipe connection 3.4" to 4". Indicator body made of special dense bronze in sizes up to and including 100 G.P.M. Larger bodies made of cast iron. Indicators can be furnished of nickel, cast steel, stainless steel or other desired alloys.

HENSZEY

FLOW INDICATORS

Continuous Blowdown • Distillation Systems • Heat Exchangers
Feed Water Meters • Boiler Feed Regulators • Proportioning Valves

OBITUARIES

Albert H. Killinger

ALBERT H. KILLINGER, Vice-President and Director of Laclede-Christy Clay Products Co., St. Louis, Mo., died at Durango, Colorado, Friday, August 18, after a brief illness.

At the time of his death, Mr. Killinger was on a vacation and had previously been in good health. He is survived by his widow, Ellen K., a son, Herbert F., 24, now in military service, and a daughter, Jane, 16. The family home is at No. 7, Fair Oak, Ladue, Missouri.

Mr. Killinger, who was born at Collinsville, Ill., August 29, 1894, became connected with the Laclede-Christy Co. as Traffic Manager, April 17, 1919 and assumed additional duties as purchasing agent, a few years later.

In 1935, he was promoted to the position of Division Sales Manager, and in 1938 became Vice-President in Charge of General Refractory Sales. In 1942, he was placed in charge of all sales, and one year later became a Member of the Board of Directors.

Shelby M. Jett

SHELBY M. JETT, a director and secretary of The B. F. Goodrich Co., died suddenly August 9 of a heart attack while aboard an airlines plane approaching Cleveland Airport from Detroit. Mr. Jett had been secretary of B. F. Goodrich since 1927.

Mr. Jett was born in Richmond, Ky., 55 years ago. After being graduated from high school he entered Hampden-Sydney College where he took his A. B. degree in 1911. He then went to the University of Virginia Law School and obtained his law degree in 1914.

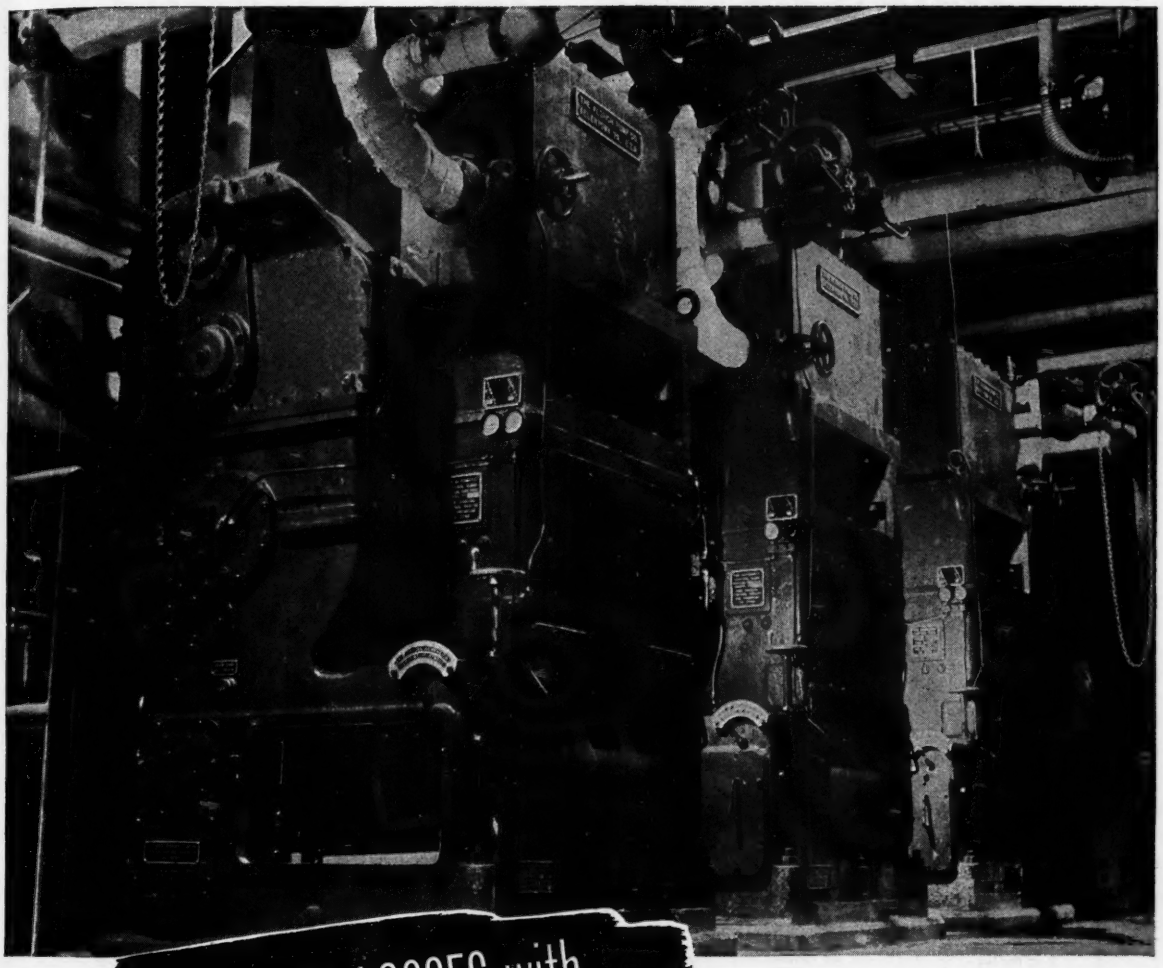
For a few years after graduation Mr. Jett practiced law in the South, experiencing all the problems confronting the young professional man endeavoring to make a place for himself in the business world. He had heard of B. F. Goodrich and believing there might be an opportunity there for him he came to Akron in 1917, going to work in the stock regulation department.

A year later he was transferred to the legal department and nine years later, in 1927, his energy and close application to his duties had won for him the post of secretary. After he became secretary he headed the legal department as well.

The B. F. Goodrich secretary is survived by his widow, Julia; a son, Alexander, attending the University of Colorado, and two daughters, Mrs. William Boardman of Akron, and Mrs. Tress Pittinger, Jr., of Nashville, Tenn. Five brothers also survive him. They are Richard of Cleveland, Raymond of San Antonio, Jeptha of Danville, Ky., Covington of Cox Creek, Ky., and Charles of Lexington, Ky.

Dr. Frank Jerome Tone

DR. FRANK JEROME TONE, Chairman of the Board of Directors, of The Carborundum Co., died at his home at Niagara Falls on Wednesday, July 26, after a long illness. Dr. Tone was one of the pioneers in the field of science dealing with electrochemistry and elec-



CUT POWER LOSSES with . . .

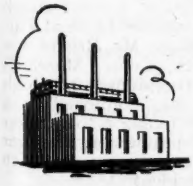
. . . ALDRICH-GROFF CONTROLLABLE CAPACITY "POWR-SAVR" PUMPS

Aldrich-Groff pumps on unit feed systems eliminate pressure and power losses common to throttling-type feed regulating valves and offer advantages of feed system simplicity, efficiency and mechanical reliability for small and medium installations at medium and high steam pressures.

Equally important overall power savings are effected by Aldrich-Groff pumps on de-superheater feed service in connection with high pressure topping units for power stations of any size.

The three Aldrich-Groff 3¼" x 0 to 6" variable stroke vertical triplex pumps shown above are in service in a mid-western central station employing the unit system for main boiler feed. Two are driven by constant speed motors and the third by a constant speed steam turbine. Power consumption is almost directly proportional to pump delivery.

The 6" stroke — 3¼" plunger pump is a 100 HP unit and when operating at maximum speed can deliver 70,000 pounds of feed water per hour against 1025 pounds boiler pressure.



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for bulletins and material giving full details, sizes and ratings of Aldrich-Groff Pumps.

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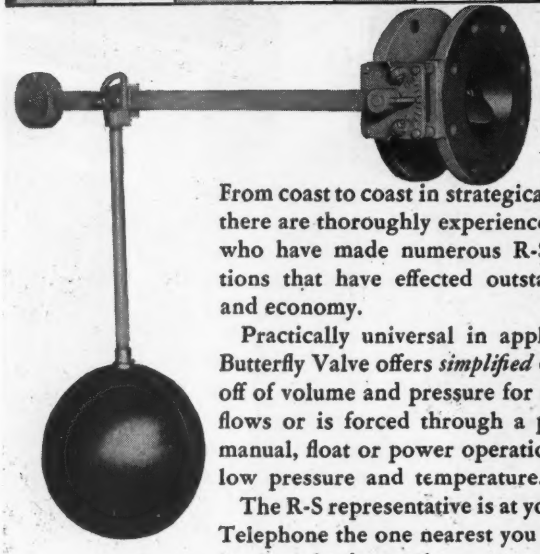
National R-S Valve Engineering Service



No. 579

No. 579. Direct action float valve with counterweight assembly.

From coast to coast in strategically located cities, there are thoroughly experienced R-S Engineers who have made numerous R-S Valve installations that have effected outstanding efficiency and economy.

Practically universal in application, the R-S Butterfly Valve offers *simplified* control and shut-off of volume and pressure for any material that flows or is forced through a pipe—adapted to manual, float or power operation under high or low pressure and temperature. 15 to 900 psi.

The R-S representative is at your beck and call. Telephone the one nearest you for prompt service or write for catalog.

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R-S Streamlined BUTTERFLY VALVES

trometallurgy. He made many contributions to industry through his research and talents.

He was born in Bergen, N. Y., October 16, 1868, obtained his early schooling at the Brockport, N. Y., Normal School and later entered Cornell University from which he graduated with the degree of Mechanical Engineering in 1891. He immediately secured a position with the Thomson-Houston Electric Co. and was later employed by the Pittsburgh Traction Co. In 1895 he was engaged by the late Dr. Edward G. Acheson, who had a few years earlier developed the abrasive known to industry as Carborundum. Dr. Tone was engaged as plant engineer and the factory was moved from Monongahela to Niagara Falls, N. Y., where he was associated with such personalities as Charles Hall, Wilson, Price, Horry, Bradley and Lovejoy.

His achievements included an intensive study of the properties of abrasives as well as the processing and development of grinding wheels and other abrasive products so widely used by industry. His work in the development of super refractories was notable.

In 1900 he was awarded the Paris Exposition Medal; in 1901 the Pan American Exposition Medal and in 1904 the St. Louis Exposition Medal. He was president of the American Electrochemical Society in 1918-1919. The degree of Doctor of Science was conferred upon him by the University of Pittsburgh in 1935, and in the same year he was given the Edward Goodrich Acheson Medal by the Electrochemical Society.

Dr. Tone is survived by his widow, Gertrude Franchot Tone, two sons, Frank, Jr. of Niagara Falls, Franchot Tone of Hollywood, three grandsons and a granddaughter.

Wirt S. Quigley

WIRT S. QUIGLEY, president of Quigley Company, Inc., and former president of the Federal Grand Jury Association for the Southern District of New York, died Sunday, July 16, at his home at the age of 69 years. He is survived by his widow, Gertrude B. Quigley.

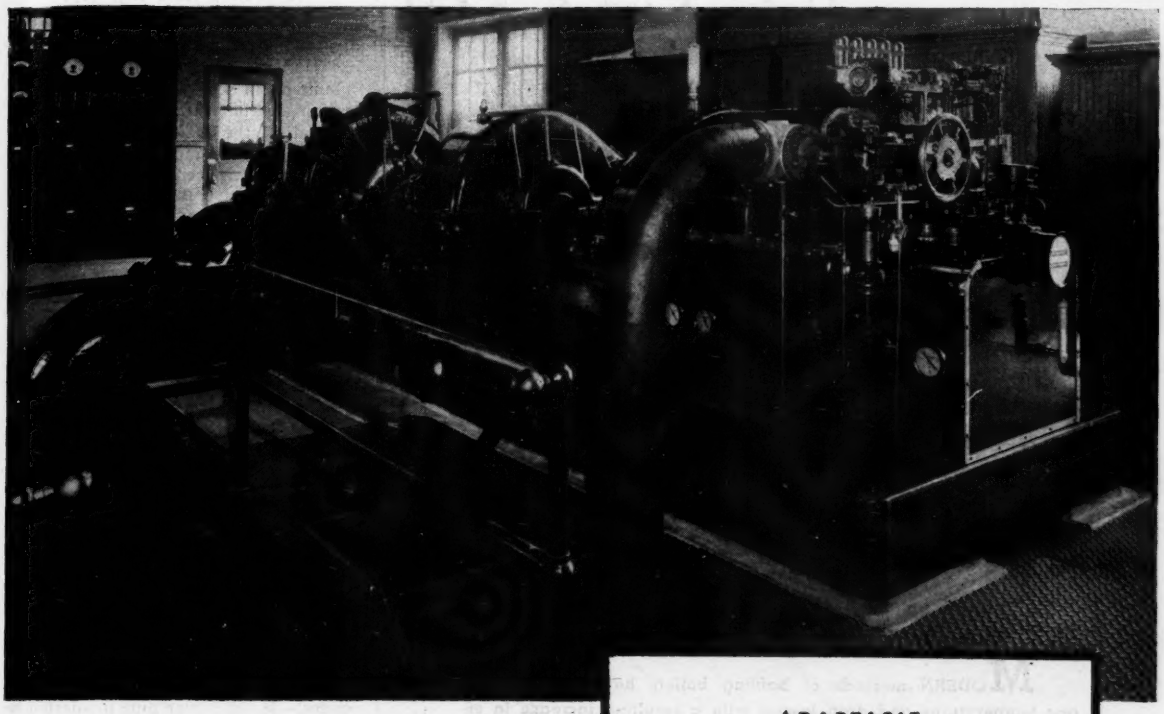
Edgar H. Bristol

EDGAR H. BRISTOL, President of The Foxboro Co., Foxboro, Mass., and one of its founders, died of a heart attack on July 24, at his summer home at Falmouth Heights, Mass. Mr. Bristol was born at Naugatuck, Conn., March 7, 1871, and after completing his high school education was employed as a machinist, later becoming a tool-maker and subsequently production manager of the instrument company of which his father was president.

In 1908, together with his brother Bennet B. Bristol, they organized the Industrial Instrument Co. which, on January 1, 1914, became The Foxboro Co. He served as president throughout its history. More than forty patents were recorded to his credit, some of them so basic in character as to establish new principles of instrument design and operation. The helical spring, which is the measuring element in temperature and pressure recorders, is an example of his inventive genius.

He is survived by his widow, a son, four daughters and sixteen grandchildren.

COMPLETE UNIT RESPONSIBILITY



THIS Worthington-Moore turbine-driven centrifugal pumping unit was installed by the Water Works Department of the City of Lansing, Michigan, in 1941.

Turbine, gear, main pump, condenser and auxiliaries were engineered as a unit for maximum efficiency and uninterrupted service.

A Worthington-Moore condensing steam turbine, with double-helical reduction gear, drives a Worthington centrifugal pump capable of delivering 20 million gallons per day against discharge head of 200 feet.

Worthington—world's largest manufacturer of pumps, with broad experience in steam power equipment – combined with Moore's years of turbine engineering, can build the same year-in, year-out, trouble-free service into *your* Worthington-Moore steam turbines. Write us. Worthington Pump and Machinery Corporation, Moore Steam Turbine Division, Wellsville, N. Y.

ADAPTABLE
TO HIGHER STEAM PRESSURES

Now operating on steam at 160 lbs. pressure, exhausting to 29" vacuum, the construction of Lansing's Worthington-Moore turbine is suitable for future steam conditions of 400 lbs. pressure and 750°F. total temperature. Automatic nozzle control permits greatest efficiency at reduced pumping rates.

WORTHINGTON PUMP AND MACHINERY CORPORATION
HARRISON, NEW JERSEY
MOORE STEAM TURBINE DIVISION, WELLSVILLE, NEW YORK

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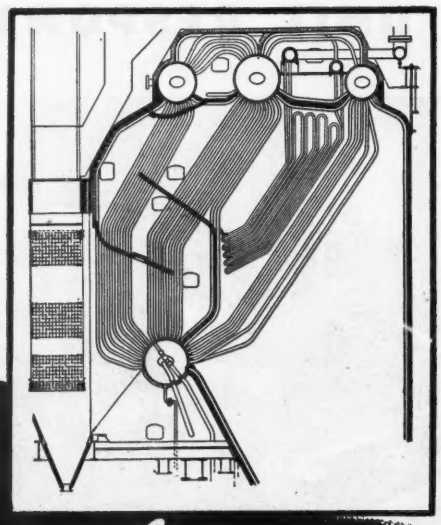
MR4-4



Streamlining SAVES FUEL

MODERN methods of baffling boilers have reduced flue gas temperatures and draft losses, with a resulting increase in efficiency, capacity, economy of operation and ultimate saving of fuel.

Enco Streamline Baffles are built gas tight and at any angle across the tubes, or interbank spaces, in all water tube boilers. The construction provides for easy removal of tubes and is a life time job.

The long sweeping curves promote the smooth rapid flow of gases over practically every square foot of the heating surface — gas passes are tapered in correct proportion to the contraction of the gas as it cools to maintain gas velocity. Bottle necks, dead gas spaces and soot pockets are eliminated with resulting better heat-transfer and minimum draft-loss.

Flexibility in design and construction permits baffles to be placed in the most effective position instead of a convenient location for easy installation.

Since boilers differ as to size and location of superheaters, number of drums, location of damper, nature of fuel, use of arches, water walls, etc., the design of an Enco baffle for each boiler is an engineering study which requires, and gets, individual study.

FREE BOILER BAFFLES

● A bulletin on boiler baffles gives valuable information which every engineer should have. Ask for bulletin BW 44 It's free.

THE ENGINEER COMPANY

75 WEST STREET • NEW YORK 6, N. Y.

Enco Streamline Baffles

PRODUCED EXCLUSIVELY BY THE ENGINEER COMPANY

Insulation— How to Install It

(*Continued from page* 100)

ment, block insulation, or molded-type pipe insulation, as specified.

(1) Insulating cement shall be built up in separate coats no greater than ¾ in. thick, to a thickness equal to the insulation on adjacent piping by the method shown above for insulating cement and shown in Fig. 8. (See Fig. 15)

(2) Blocks of a thickness ½ in. less than the insulation on adjacent piping shall be carefully installed on large fittings (approximately 4 in. and up in diameter) and secured in place with No. 16-gage galvanized wire. A ¼-in. coat of insulating cement shall then be applied, troweling it well into the cracks between adjacent blocks. (See Fig. 16.)

(3) Molded-type pipe insulation may be used to insulate flanged couplings. Rings of sectional pipe covering 1½ to 2 in. wide should be wired in place on each side of the flange, selecting an insulation thickness that will provide an outside diameter equal to or greater than the flange diameter. A piece of sectional pipe insulation long enough to cover the flange should then be banded in place. (See Fig. 17.)

Application of finish located indoors.—Molded-type pipe insulation located *indoors* and not exposed to moisture or abrasion shall be finished with a canvas jacket.

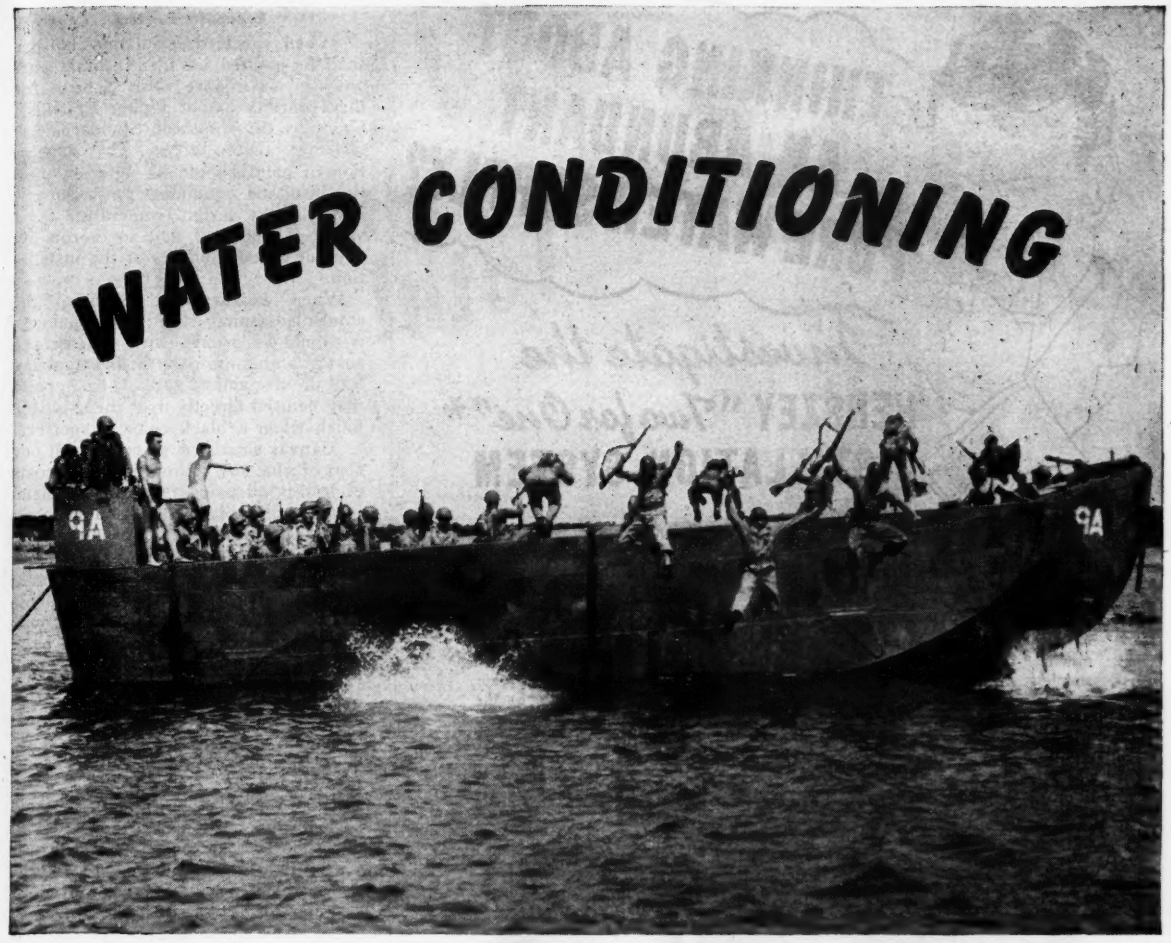
(1) The factory-weight canvas jacket furnished shall be drawn tight and smoothly pasted down at all side and end laps. Factory bands shall be applied, one binding the adjacent ends and one at the center of each section.

(2) When extra-weight canvas jacket is specified, the factory-weight canvas and bands (if furnished) shall be omitted. The pipe insulation shall be enclosed in 40-lb rosin-sized paper, over which the specified 6- or 8-oz canvas jacket shall be sewed neatly in place with stitches spaced not more than ⅓ in. apart, with seams located where least visible.

Insulation on flanges, valves, and fittings located *indoors* or not exposed to moisture or abrasion shall be covered with a ¼-in. coat of insulating or finishing cement. Portland cement may be added to provide a harder finish.

(1) When specified, a 6- or 8-oz canvas jacket shall then be sewed or pasted neatly over the dry cement. Sewed canvas jackets on valves, flanges, and fittings shall be made continuous with the canvas on adjacent piping by overlapping or blind stitching.

Application of finish located outdoors.—Molded-type pipe insulation and fittings located *outdoors* or exposed to moisture or abrasion shall be provided with a weather-proof protective finish in the same general manner as specified for blanket-type pipe insulation.



● Water conditioning tactics developed for the protection of our invasion troops have no place in your power plant... but... there are modern water conditioning methods available to industry which bring equally valuable end results.

Water that is conditioned to remove objectionable dissolved minerals, hardness, corrosion, oil, suspended matter, etc. will protect your production schedules, safeguard irreplaceable power plant equipment, save precious fuel and reduce labor costs.

The power plant, so vital to the war effort, can have the protection of Infilco equipment for boiler or evaporator feedwater treatment, cooling water conditioning, condensate oil removal, steam purification, etc.... as well as Infilco chemical feeders and trade waste treating equipment. You are invited to make use of Infilco's 49 years experience in these allied fields. Call on our Engineering Staff. There is no obligation.

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ACCELATOR SOFTENERS • CHEMICAL FEEDERS • PROPORTIONERS
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ARMY NAVY

THINKING ABOUT AN ABUNDANT PURE WATER SUPPLY?

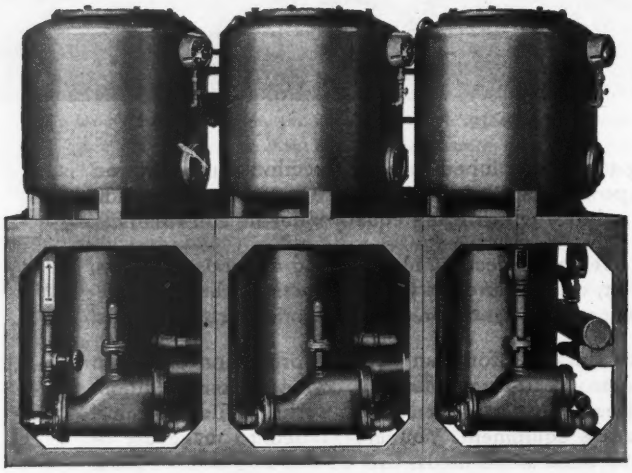
Investigate the

HENSZEY "*Two for One*"* DISTILLATION SYSTEM

This Henszey unit is a compact and extremely efficient evaporator that produces adequate supplies of fresh water of highest quality and purity . . . an important item in certain manufacturing methods, food processing, chemical formulations, power production and human consumption.

Henszey Distillation Systems can be built in any desired capacity from 3,000 to 50,000 pounds per hour in one single, compact unit. They can be furnished with or without integral boilers. They can be fabricated from steel, stainless steel, monel, copper or combinations of the above to meet your purpose. Get to know more about these remarkable units—they may be the answer to an abundant low cost supply of pure water required in your post war plans . . . or they may be the answer to an immediate war production problem now.

HENSZEY CO., Dept. C 9, Watertown, Wis.



***6 EFFECT EFFICIENCY with only 3 EFFECTS**

A remarkable achievement of design and performance!

HENSZEY

DISTILLATION SYSTEMS

Continuous Blowdown • Heat Exchangers • Boiler Feed Regulators

Feed Water Meters • Flow Indicators • Proportioning Valves

Guides for Painting

When specified, insulation finishes shall be painted for identification purposes in accordance with "Scheme for the Identification of Piping Systems," issued by the American Standards Association (A13—1928). The application of paint should be deferred until the insulated equipment has been operated at the design temperature for a sufficient length of time to thoroughly dry out all components of the installation.

When weatherproof finish of the emulsified-asphalt type is to be painted, it should be primed with at least one coat of aluminum paint before applying lead-in-oil paint. Asphalt-base paint may be used directly over the asphaltic finish when a black color is specified.

Canvas should be given at least one coat of glue size followed by two coats of lead-in-oil paint. Galvanized metal is not ordinarily painted immediately following application. If painting is required, it should be done in accordance with manufacturers' directions. Insulating cements and finishing cements ordinarily dry to a light color, and may be painted with a nonpenetrating paint such as aluminum.

Maintenance

In order to maintain high thermal efficiency in conjunction with long insulation life, the following recommendations are made:

(a) Inspect all insulation jobs periodically, particularly those located outdoors or exposed to moisture, vibration, or abrasion.

(b) When equipment is moved, or if for other reasons the finish of the insulation is damaged or becomes loose, repair or replace as required to prevent deterioration.

(c) For advice on problems in connection with any specific insulation application, consult the manufacturer or the contractor who applied it.

Polarized Light Servo-System

(*Continued from page* 95)

A small d-c generator is attached to the shaft of the motor and its output voltage is applied through capacitor (C_1) between the grid and cathode of tube (2). The voltage (e) generated by this generator is proportional to the speed (w) of the secondary shaft. For the frequencies encountered the current through C_1, and therefore the voltage across the grid resistor of the tube (2), is proportional to $\frac{de}{dt}$, and is therefore proportional to $\frac{dw}{dt}$, the acceleration of the shaft. Thus, the condition of balance of the two light beams is anticipated, and the system is stabilized and remarkably free from the hunting or oscillation commonly experienced in servo systems.

It will be noted that a single lamp is used as a light source for both beams of light so that any changes in the light output due to aging, darkening of the

This VALVE is worth Looking Into!

LOOK into this sturdy OIC Cast Steel Valve and get the true inside story of the many benefits to be derived from its use.

Look at its sturdy hand wheel and the long thread engagement between yoke sleeve and stem which means low thread bearing pressure.

Look at its two-piece yoke and pressure-lubricated yoke sleeve.

Look at the self-aligning two-piece gland assembly, with gland and follower held together by self-locking lugs and raised together for quicker, easier repacking under pressure.

Look at the safe, convenient gland eye-bolts that swing down out of the way during repacking and are never lost.

Look at the extra deep stuffing box with metal-core braided asbestos packing rings for an efficient seal and less frequent maintenance.

Look at the deep condensing chamber, assuring longer packing life.

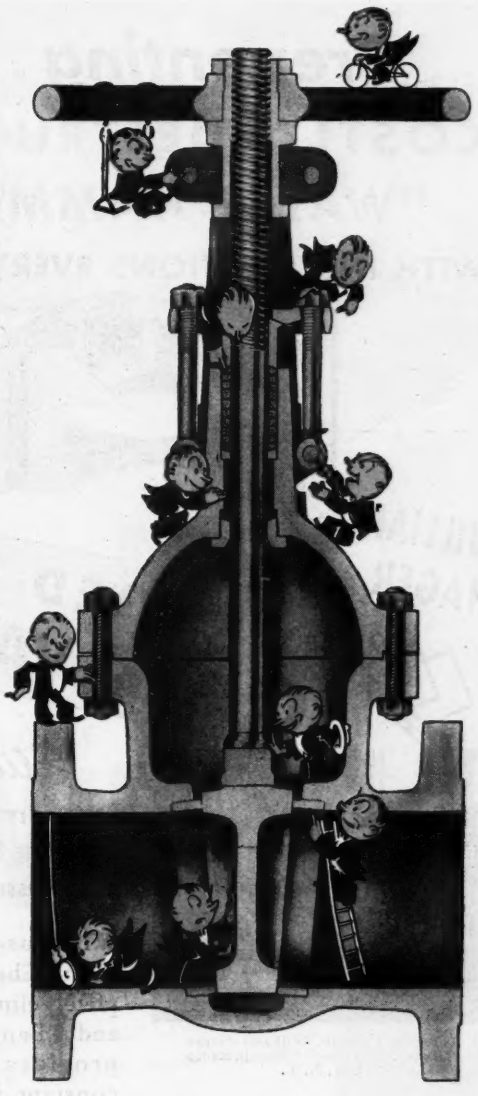
Look at the full-threaded bonnet stud bolts especially designed for maximum tension loads under specified operating conditions.

Look at the rugged T-slot connection between stem and wedge, to prevent lateral strains on stem.

Look at the barrel-type seat rings for positive seating.

Look at the heavy I-beam type solid wedge.

Look at the straight-through streamlined ports.



OIC Cast Steel Valves . . . Gates . . . Globes . . . Angles . . . Checks . . . are available in the 150 and 300-pound pressure classes, with screwed, flanged or butt welding joints.

There is an OIC Distributor near you who is ready to demonstrate to you the many superior features of OIC Cast Steel Valves. Call him or write to us for full details.

ARMY E NAVY

OIC

THE OHIO INJECTOR COMPANY

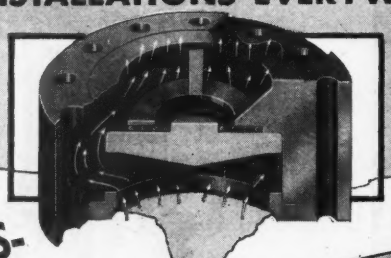
WADSWORTH, OHIO

Quality Leaders in Valve Manufacture Since 1883

Preventing . . .

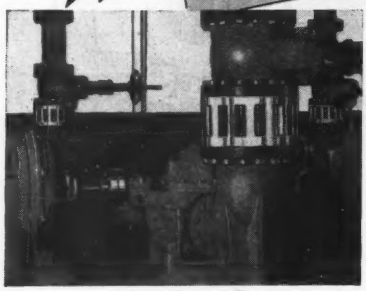
COSTLY, DESTRUCTIVE "WATER HAMMER"

WITH INSTALLATIONS EVERYWHERE!



WILLIAMS-HAGER

FLANGED Silent CHECK VALVES



Three 10"-300 lb. Williams-Hager Flanged Silent Check Valves in Radio City, N. Y.

Eliminates

Costly Breakdowns in Pumps and Piping Systems with Operating Pressures up to 6000 lbs!

Williams-Hager Flanged Silent Check Valves completely eliminate "Hammer" and "Bang" in the lines, provides uninterrupted constant flow of liquids.

Unlimited in size or application, from 1" to 20", built of materials to best suit the end use, Williams-Hager Flanged Silent Check Valves have been chosen for years as standard equipment in such exacting line uses as oil, gasoline, acids, water, chemicals, gas, salt water, brine, etc., etc., regardless of temperature.

Write today for interesting folder on "Water Hammer—Cause, Effect and Control in Piping Systems."

THE WILLIAMS GAUGE COMPANY

Pump Valves . . . Water Gauges . . . Gauge Cocks . . . Pump Governors . . . Steam Traps Feed Water Regulators . . . Water Columns

3000 PENNSYLVANIA AVENUE • PITTSBURGH (12), PA.

bulb, and input voltage affect equally the light falling on both phototubes, causing no unbalance of the system. The bridge circuits employed also make the electronic circuits relatively free of unbalance due to supply voltage fluctuations.

The secondary shaft will follow the primary shaft in angular position with an accurary of plus or minus one or two degrees. This accuracy will be affected by the non-uniformity of polarization in the polarizers and non-uniformity of light transmission through them. Since the primary and secondary polarizers normally operate at 45 deg to each other, the rate of change of light transmission with respect to angular displacement is a maximum. Therefore, the angular errors due to variations in the polarizers are at a minimum.

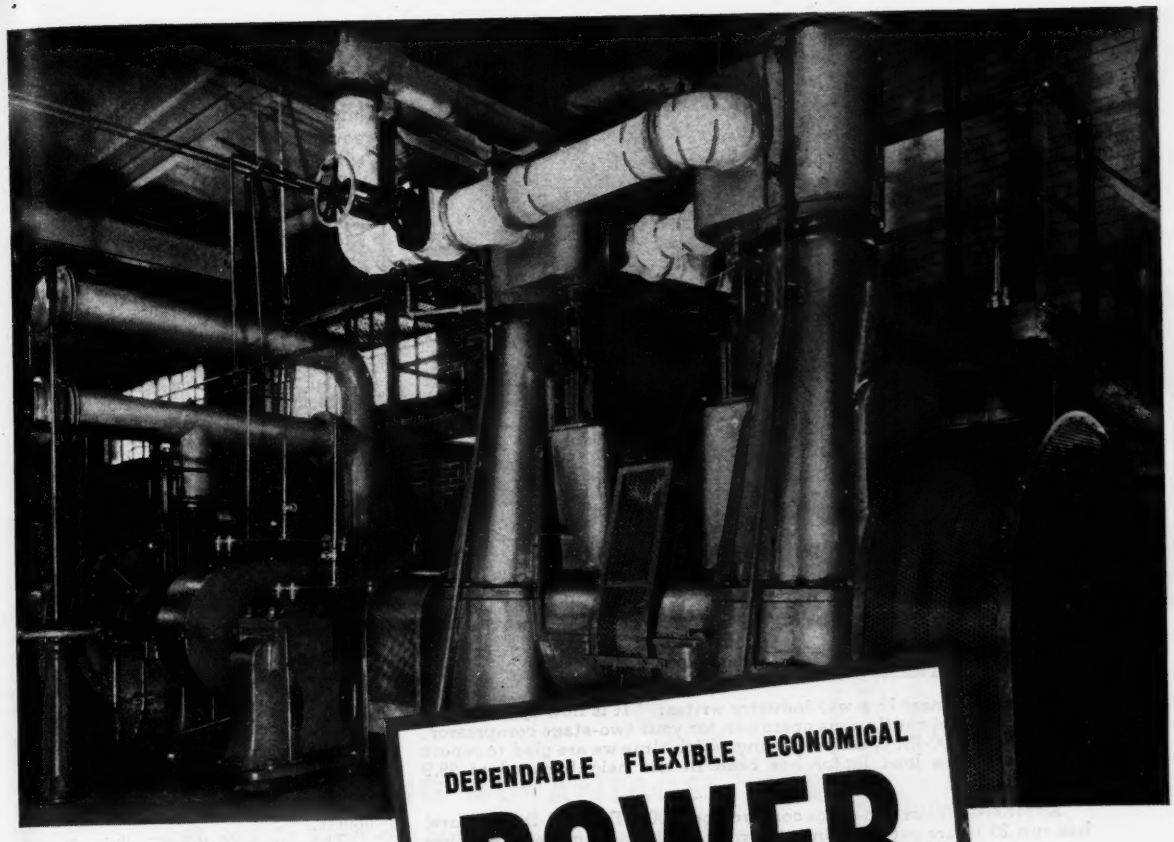
The polarized light servo-system is being used successfully in a number of different applications, principally in new electro-mechanical instruments for accurately solving problems involving integration. Referring to Fig. 1, the radius (r) at which the integrating wheel rolls on the turntable is variable by means of a cam or screw and represents the integrand. If θ is the angular displacement of the turntable, the angular displacement of the integrating wheel and primary shaft p is proportional to $\int r d\theta$

$$p = k \int r d\theta$$

The angular displacement of the secondary shaft is the same as that of the primary shaft and integrating wheel and since considerable power is available to drive this shaft it can be loaded to drive other calculating and recording mechanisms. The view of the mechanism on page 76 shows how the servo-system is incorporated in the calculating and recording unit of the General Electric integrating pressure traverse recorder which is used by the Research Section of the G. E. Turbine Engineering Division in its Air Test Laboratory for studying flow phenomena through turbine passages. In this machine the integrated values will check each other within 0.01 per cent on repeated integration of the same function. These errors are largely due to mechanical tolerances. This indicated that the slippage of the integrating wheel on the turntable is extremely small.

Coal Segregation in Boiler Plants—Correction

WHILE the August 1944 issue of POWER PLANT ENGINEERING was on the press, the editor's attention was called to the inverted position of Fig. 8, page 71. The cut was immediately turned on the press but unfortunately the illustration appears in a number of copies mailed to readers. The text in the third column on page 72 describes correctly how segregation takes place in a chute of this type.



TROY ENGBERG

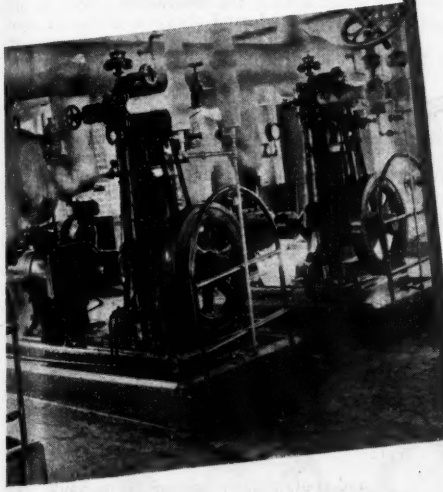
DEPENDABLE FLEXIBLE ECONOMICAL

POWER

POWER for driving stokers, blowers, fans, generators, compressors, pumps, cookers, dryers, exhausters—HEAT UNITS for processing or heating. This is "By-Product" Power . . . a two-in-one service from the steam you are generating.

The Troy-Engberg Steam Engine is always dependable. It gives steady, unfailing operation for years without requiring major repairs. It has a wide speed range, providing great flexibility. It has high starting torque and high sustained overload capacity; freedom from fire hazard.

Records show that for many operations, the Troy-Engberg Steam Engine is the *best* drive. Keep this in mind when ready to take up that post-priority installation.



TROY ENGINE & MACHINE CO.

Established 1870

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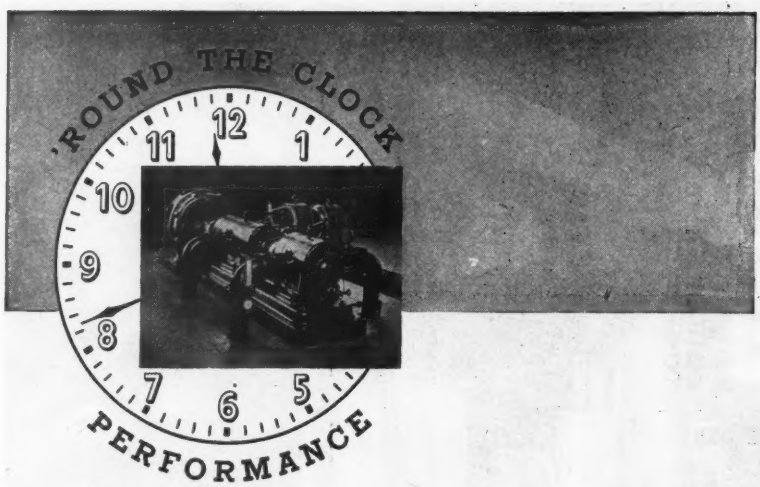

Fuller Rotaries Give it to You

FACTS THAT PROVE THEIR WORTH . . .

A plant engineer in a war industry writes: "It is now approaching the third year of continuous operation for your two-stage compressor, (1800 C.F.M., 100-lb. pressure) during which time we are glad to report that the service load factor has been in the neighborhood of 99.9 per cent."

Another—"Your two-stage compressor, (100 C.F.M., 90-lb. pressure) has run 23 hours per day almost continuously for four years and has given no trouble." Not a cent was spent for repairs during these four years.

In a foundry—"During three years' operation only $3.90 was spent for repairs on a two-stage compressor. (330 C.F.M., 100-lb. pressure)."

Performance such as this warrants your careful consideration . . . lost time can never be recovered. Install Fullers for day in and day out service. Get acquainted with Fuller Rotaries . . . send in the coupon below.

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FULLER COMPANY
Catasauqua, Pa.

Please send Bulletin C-5, describing Fuller Rotary Compressors and Vacuum Pumps.

Name.....Title.....

Company.....

Address.....

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C-88

FULLER COMPANY
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CHICAGO, 3 Marquette Bldg. WASHINGTON, 5, D.C. Colorado Bldg. SAN FRANCISCO, 4 Chancery Bldg.

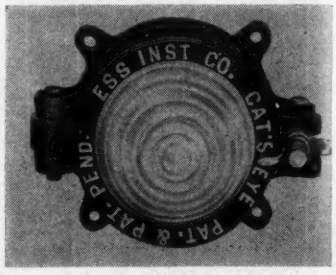
NEW EQUIPMENT

Information that you desire about any equipment will be gladly furnished without obligation. WRITE TO POWER PLANT ENGINEERING

Flame Viewer

FIREBOX flame and smoke-haze, characteristics of a boiler furnace, are constantly indicated by the fire "Cat's-Eyes", developed by the Ess Instrument Co. of Fort Lee, N. J.

The Cat's-Eye has no glare, doesn't get hot and will not permit flareback. By looking at it the operator will see, at a glance, the furnace flame, its turbulence and its smoke-haze and be able



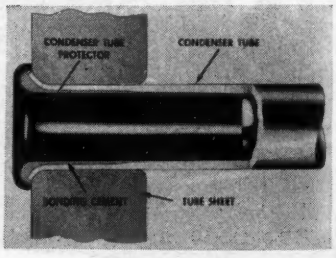
to make the necessary adjustments in fuel-air ratio without leaving his station, This applies to one or a number of boilers.

The center of the "Eye" is clear to show the flame in all of its natural color and the outer frosted portion is a sensitive shadow-screen reflecting the slightest change in combustion. Cat's-Eyes are easily attached to burners or peepholes.

Condenser Tube Protectors

PROTECTION of condenser tube inlet ends against the destructive effect of air erosion and sand abrasion is the purpose for which the John Crane Condenser Tube Protectors were developed by the Crane Packing Co., 1812 Cuyler Ave., Chicago 13, Ill.

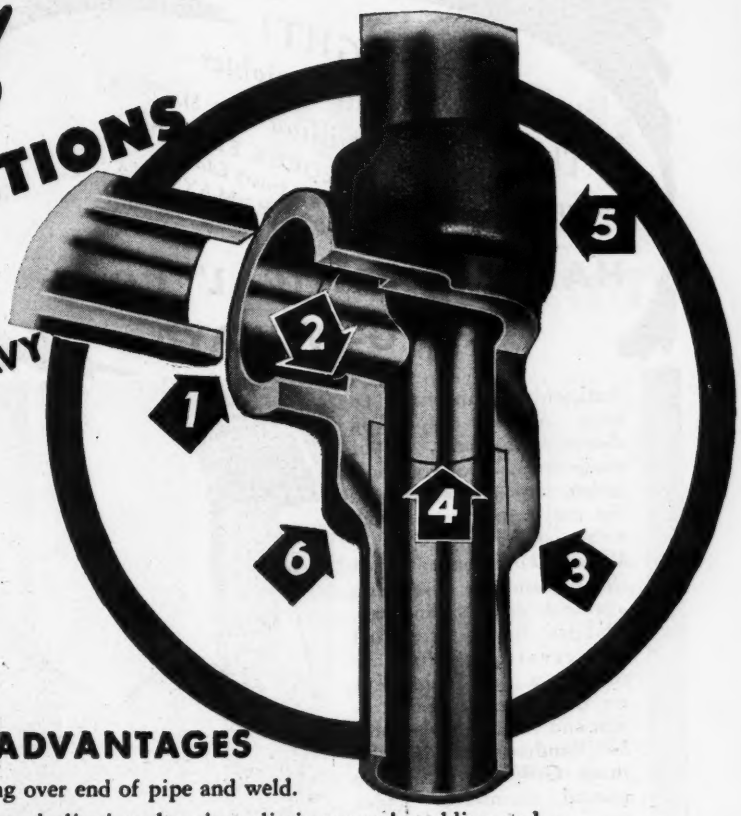
These tube protectors are molded of a special wear-resistant, hard Bakelite material, unaffected by temperatures of 275 F and resistant to air impingement



and contaminated salt or fresh condenser circulating water. They fit inside the inlet end of the tubes as illustrated, are securely cemented in place and provide a bell-mouth Venturi entrance for the circulating water.

They are available for all marine and stationary power plant condensers to fit tubes of the following sizes: 5/8 in. 16 and 18 gage; 3/4 in. 16 and 18 gage; 7/8 in. and 1 in. 18 gage.

Speed PIPE CONNECTIONS ON STANDARD EXTRA HEAVY AND DOUBLE EXTRA HEAVY PIPE LINES

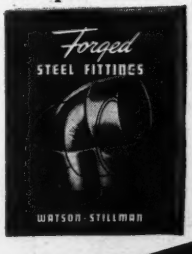


TIME-SAVING ADVANTAGES

- ***Easy To Install***—slip fitting over end of pipe and weld.
- ***Deep Socket***—supporting and aligning the pipe, eliminates tack welding and the use of special fixtures. Accurate measuring and cutting of pipe unnecessary —Ample come—and—go.

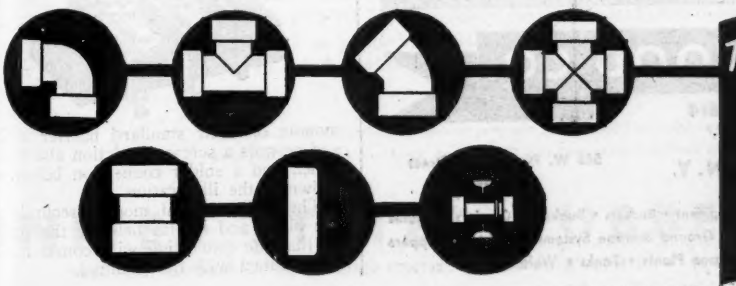
MAINTENANCE-SAVING ADVANTAGES

- ***Position of Weld***—prevents welding icicles inside pipe—no clogged lines. Wall sections 1¼ times the nominal pipe thickness permits proper heat penetration and correctly proportioned fillet weld.
- ***Smooth Flow***—assured as inside diameter of fitting matches inside diameter of pipe.
- ***Long Bands***—extending well beyond bottom of socket, provide ample reinforcement, eliminating weak sections.
- ***Strong, Trouble-free Joints***—the fitting and pipe are fused into one integral unit permanently tight and leak-proof. Unaffected by vibration, distortion and shock.



W-S Forged Steel Socket Welding Fittings are machined from solid drop forgings. Available for use with Standard Pipe—Schedule 40 Extra Heavy Pipe—Schedule 80 and Schedule 160 Pipe, and Double Extra Heavy Pipe. Sizes ¼" to 4" I.P.S. Each class can be furnished in Carbon Steel; Carbon-Molybdenum Steel; Chromium-Molybdenum, Steel or Stainless Steel. Conform to ASA Standards. Ask for Bulletin A-3.

Sold Through Leading Distributors



The WATSON-STILLMAN Co.
ROSELLE, NEW JERSEY

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"COAL IS TIGHT!
This winter it will be tighter—
an estimated 20-million-ton shortage"
—GEORGE EDWARDS
Advisory Editor
POWER, MAY 1944

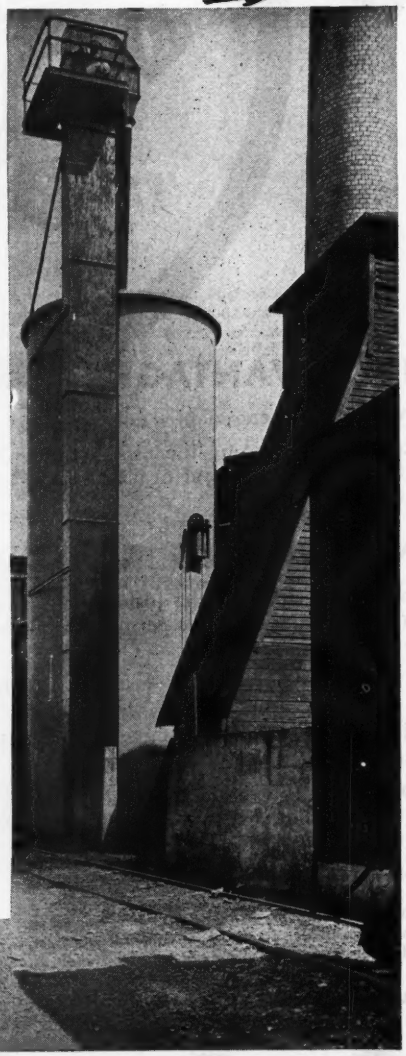
HANDLE "CRITICAL" COAL
THE G-W WAY

Authorities continue to warn of an impending shortage of coal . . . of manpower . . . of transportation, imposing a crisis in the coal industry — which means *all* industries.

Power plants have sensed the situation — wise managements are checking possibilities for greater fuel conservation. They are turning a questioning eye on their present coal storage and handling methods. In hundreds of installations G-W systems have proved themselves under wartime and normal conditions. As designers and builders of coal storage and handling systems G-W is ready to apply its unsurpassed 130 years' experience to your problems.

By an ingenious combination of standard and special designs G-W can meet your individual requirements promptly, efficiently and economically, in cooperation with your own engineers.

Why not ask for a plan and proposal? Catalog P-200 will give you help, too. Write for a copy.



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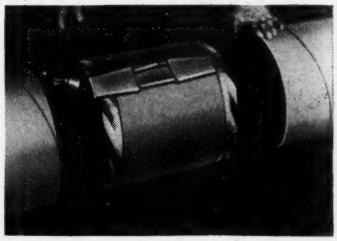
Ash Spouts • Barge Unloading • Bins • Boiler House Equipment • Buckets • Bunkers • Carriers • Chutes
Conveyors • Crushers • Elevators • Feeders • Gates • Ground Storage Systems • Hoists • Hoppers
Infra-Red Drying Systems • Screens • Silo Storage Plants • Tanks • Weigh Larries

Coupler for Prefabricated Conduit

MAKING FINAL field connections on Ric-wiL Prefabricated Insulated Pipe Conduit, a product of The Ric-wiL Co., 1572 Union Commerce Bldg., Cleveland, Ohio, has been greatly facilitated by a drive coupler. The coupler is adaptable to mechanical or welded closure and the operations in either case are much simpler than former methods.

Ric-wiL insulated conduit is shipped to the job site in 21 ft sections, completely prefabricated with pipe or pipes, insulation and aligning pipe supports. Ends of helical corrugated conduit are expanded smooth at the factory, removing corrugations for a distance of 3 in. Bare pipe extends beyond ends of conduit for 3 more in. After pipe has been coupled or welded, and insulation applied over exposed portions, smoothed ends



of conduit are coated with waterproof sealing cement. A heavy-gage split connector sleeve is then slipped over the opening. Clamps are driven onto wedge-shaped channels over lapped joint, quickly making a strong watertight mechanical coupling. Where a welded closure is required, cement is omitted and ends of sleeve lap-welded to conduit after clamps have been applied. Clamps are then removed and longitudinal seam lap welded. For extra strength, clamps may again be driven onto channels after weld is made.

When conduit coupling is completed, an asphalt blanket, applied with heat over the entire closure area, fuses with factory applied asphalt, assuring uniform protection at all points.

Accessories for the complete system, including expansion loops, elbows, tees, anchors, reducers, etc., are prefabricated and equipped with the same drive coupler for assembly with conduit sections.

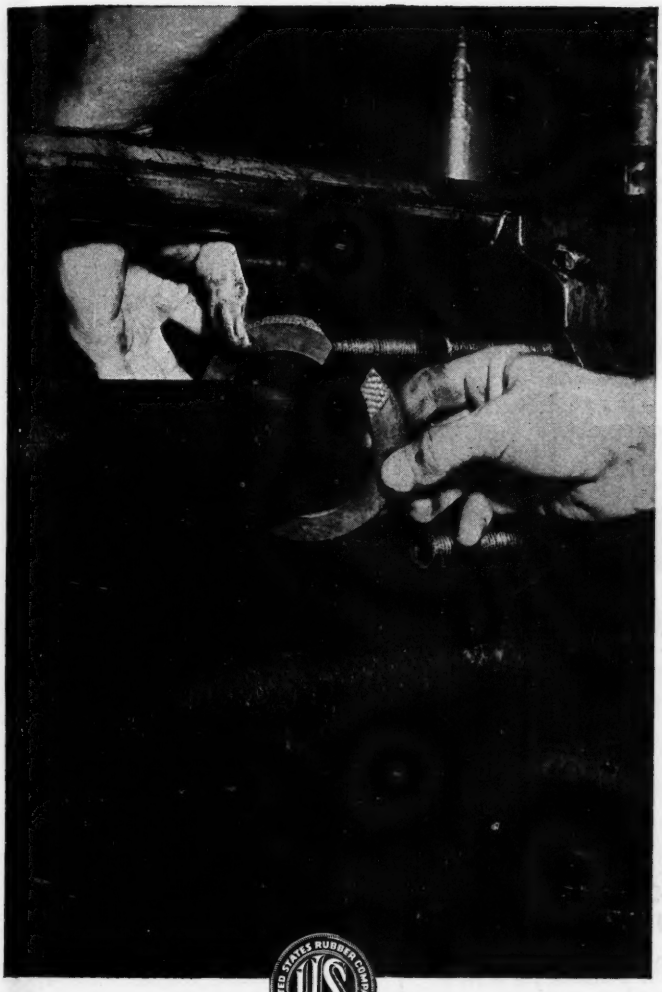
This prefabricated conduit is adaptable to underground, surface, or overhead installation.

Barrier Type Terminal Strip

TO MEET THE DEMAND for a barrier type terminal strip with facilities for connections both above and below the mounting surface, Howard B. Jones Co., 2460 W. George St., Chicago 18, Ill., designed the "Y" type terminal which

mounts on their standard barrier strips and permits a screw connection above the panel, and a solder connection below, as shown in the illustration.

The "Y" terminal mounts securely in the block and is also held by the screw so that the connecting wire comes in direct contact with the terminal.



PACKING
THAT EXPANDS AND CONTRACTS

A special cross-expansion packing—U. S. PEERLESS—was developed by United States Rubber engineers to insure a positive seal when reciprocating rods become worn, shouldered, scored or fluted.

Its construction—of diagonally-laid plies of woven duck—permits a "sliding" action on a 45° angle of the individual plies which automatically compensates for the unevenness of the rod.

Carefully checked records of this U. S. PEERLESS CROSS EXPANSION PACKING have verified every claim of satisfactory packing performance against medium or low-pressure steam, hot or cold water, ammonia, alcohol, light and mineral seal oils.

It is another example of the benefits gained by applying exact rubber technology to the practical needs of industry.

SERVING THROUGH SCIENCE

PACKING QUICKLY REPLACED—Available in sizes ¼" to 1½" inclusive, U. S. PEERLESS CROSS EXPANSION PACKING is applied quickly and easily. Furnished in spiral, coil or ring form.

U. S. PEERLESS CROSS EXPANSION PACKING—("U. S." Style No. 231) is made of diagonally laid plies of highest quality closely woven duck, bonded together with a special "U. S." rubber compound and thoroughly lubricated and graphited. It has excellent aging qualities.

Listen to the Philharmonic-Symphony program over the CBS network Sunday afternoon, 3:00 to 4:30 E.W.T. Carl Van Doren and a guest star present an interlude of historical significance.

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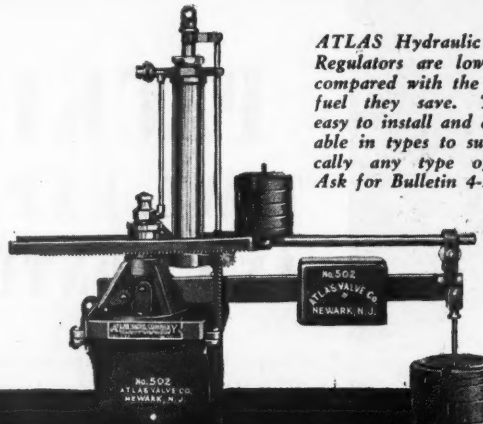


ATLAS Hydraulic Damper Regulators are low in cost compared with the value of fuel they save. They are easy to install and are available in types to suit practically any type of boiler. Ask for Bulletin 4-A.

ATLAS Damper Regulators

...provide sensitive maintenance of desired steam pressures

By proper and automatic adjustment of boiler drafts and dampers, ATLAS Damper Regulators keep CO_2 where it should be. CO is avoided. Fuel is saved and flue gas temperatures are kept down where they belong for maximum operating efficiency.

On forced draft boilers ATLAS Regulators may be arranged to control fan speed. From the fan they can be made to indirectly regulate feed rate of stokers.

AUTOMATIC HYDRAULIC OPERATION REPLACES HAND ADJUSTMENT

By utilizing water pressure acting on a piston which is connected to draft doors or dampers by chain, ample power is available for moving the heaviest doors or dampers. At the same time the control piston responds to slightest variations in steam pressure so that uniform pressure is maintained through closest adjustment of dampers and a resulting steady rate of combustion.

Low Pressure No. 501

Suitable for automatically regulating drafts of vapor or low pressure steam heating boilers. Can be adjusted to operate at any steam pressure up to 25 pounds.

Medium Pressure No. 502

Shown above. For boiler pressures up to 150 lb. Will move damper on boiler pressure changes of ¼ lb.

High Pressure No. 503

Cast Iron Base construction for boiler pressures up to 250 lb.; Cast Steel Base construction for boiler pressures up to 400 lb. Will move damper on ½ lb. boiler pressure variations.

PRINCIPAL ATLAS PRODUCTS

Check the items below on which you want information and mail to us with your name, firm name and address.

- ☐ Damper Regulators
- ☐ Temperature Regulators
- ☐ Reducing Valves
- ☐ Exhaust Control Systems
- ☐ CAMPBELL Boiler Feed Water Regulators
- ☐ Pump Governors
- ☐ Pressure Regulators
- ☐ Float Valves
- ☐ Oil Control Cocks
- ☐ Humidity Controllers
- ☐ Thermostats
- ☐ Balanced Valves
- ☐ Control Valves

ATLAS VALVE COMPANY

REGULATING VALVES FOR EVERY SERVICE

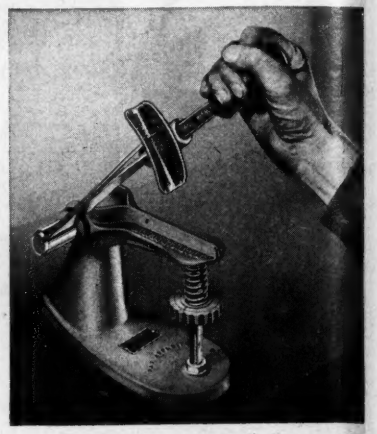
Specialists in Regulation for Nearly a Half Century

291 South St., Newark 5, N. J.

Representatives in Principal Cities

A New Spring Tester

THE P. A. STURTEVANT CO., Addison, Ill., manufacturers of Sturtevant Torque Wrenches announce a new tool for testing compression springs in sizes to 2½ in. diameter and 7 in. in length. This new tool not only makes it possible to rapidly measure the recoil pressure of a spring when compressed to any predetermined length, but makes it possible to accurately match sets of springs (as valve springs for internal combustion engines).



In design and principle the Sturtevant Spring Tester differs radically from previous spring testers in the following ways: First, it is operated with any accurate standard torque wrench, the Torque Wrench not only serving as the operating lever, but also providing the measuring element. Second, in this tester a sound device is used to indicate when the spring has been compressed to the test point . . . thus eliminating the need for the operator watching multiple dials. Third, compression of spring is against a rigid platform to prevent accumulated errors in reading. Fourth, being a lever-operated, quick action device that bolts to any bench and being extremely inexpensive, it permits general distribution to logical test, check-up and inspection points thruout a plant.

The manufacturer reports this tool so engineered and compensated that it is in itself inherently accurate and hence test readings will be as accurate as the Torque Wrench used. Developed originally as a means of accurately matching valve springs of airplane and automotive engines, the first of these tools in the field are finding a much wider range of application.

Automatic A-C Generating Set

UNIVERSAL MOTOR CO., Oshkosh, Wis., has announced the addition of an entirely new fully automatic a-c model to their line of gasoline engine driven electric light and power plants. This new model, known as the 6000-BA, is a 110-120 v plant, with a capacity of 5000-6000 w, single phase, 2 wire, 60 cycle. The plant is complete as a single unit, fully automatic with all controls mounted on the plant, a procedure not practical with more delicate and intricate fully automatic controls.

Nature made Asbestos . . . HERE'S HOW KEASBEY & MATTISON IS MAKING IT SERVE IN TODAY'S ELECTRICAL INSTALLATIONS

DO A BETTER JOB WITH

K&M EBONIZED ASBESTOS

● Thanks to greatly increased facilities this superior K&M mounting material is immediately available for electrical installations of all kinds. K&M Ebonized Asbestos is ideal for switchboards, bus bar runs, testing tables, panel boards.

This modern mounting material is a combination of asbestos fibre, binding cement and insulating compound in proper proportions—molded under intense pressure into strong, monolithic sheets.

Developed especially for the electrical industry K&M Ebonized Asbestos has many important advantages. Among these are . . .

Exceptionally high dielectric strength.
Ability to withstand severe shock, wide temperature variations and vibration.
Resistance to oil and water action.
Freedom from shrinkage, cracking, bulging.

With our expanded production we can now supply you with K&M Ebonized Asbestos in 1/8 to 4 inch thicknesses, "standard" or special "panel" finish. K&M Ebonized Asbestos meets the technical requirements of the Underwriters Laboratories, Inc., when built into an assembled unit.

Our Ambler plants proudly fly the Army-Navy "E" flag with its star —an honor awarded K&M employees "for continued outstanding production of war materials."

KEASBEY & MATTISON COMPANY • AMBLER • PENNSYLVANIA

MICRO SABOTEURS

camouflage as sludge. . .

What look like mere accumulations of mud or sludge in your process water system, may actually be caused by growths of slime, which cause needless power losses.

Not only do the growths attach themselves to the inside of pipelines and condenser tubes and seriously hamper the flow of water and heat transfer, but they entrap particles of dirt and rust to form mud-like masses.

It is not necessary, however, to tolerate such conditions with resultant handicaps in production, nor to waste time in shut-downs for mechanical cleaning jobs.

Wallace & Tiernan Chlorination Methods will thoroughly protect your plant against such microsabotage by destroying slime-forming organisms—clearing out growths already present and preventing their recurrence, without loss of production time.

Let Wallace & Tiernan Engineers suggest the most practical way to solve your particular desliming problem. CD-7

WALLACE & TIERNAN

PRODUCTS · INC.

Manufacturers of Chlorine and Ammonia Control Apparatus

Belleville 9, New Jersey • Represented in Principal Cities

Of special interest is the fact that all relays are actuated by d-c exciter current, eliminating vibration and chatter common to a-c operated relays. All relays, wire and control instruments are securely mounted and enclosed in a metal cabinet mounted on the plant.

The plant starts automatically when any load—light or appliance—of 60-100 w is turned on, and stops automatically when the last load is turned off. A service disconnect switch prevents automatic operation during periods when the plant is being inspected, lubricated or serviced. The automatic choke is a device for accurately proportioning the air and and gasoline mixture for starting and during the warm up period. It chokes the carburetor in proportion to engine temperature—saves gas, reduces crankcase dilution. Equipped with automatic circuit breaker, no extreme overload can damage the electrical or mechanical parts. It is also fused against short circuits.

Heavy Duty Steel Heater

A NEW HEATER for heavy duty applications in industrial heating, air conditioning, vapor absorption, drying and other processing work has been announced by B. F. Sturtevant Co., Hyde Park, Boston, Mass. Due to the addition of fins to the heater pipes, the heating capacity has been increased 10 times.

These heaters are constructed of 1 in. standard steel pipe threaded into cast iron headers. Inside these pipes are ⅜ in. steel pipes which carry the steam from the header, distribute it uniformly to all heater pipes, prevent air binding and provide a non-freeze characteristic.

Wound around the heater pipes are

Above: Complete unit. Right: Cross-section showing header and inner tube construction

spiral fins made of soft carbon steel strip 9/32 in. wide and tapered from 0.035 in. thickness at the edge attached to the pipe to 0.012 in. at the outside edge.

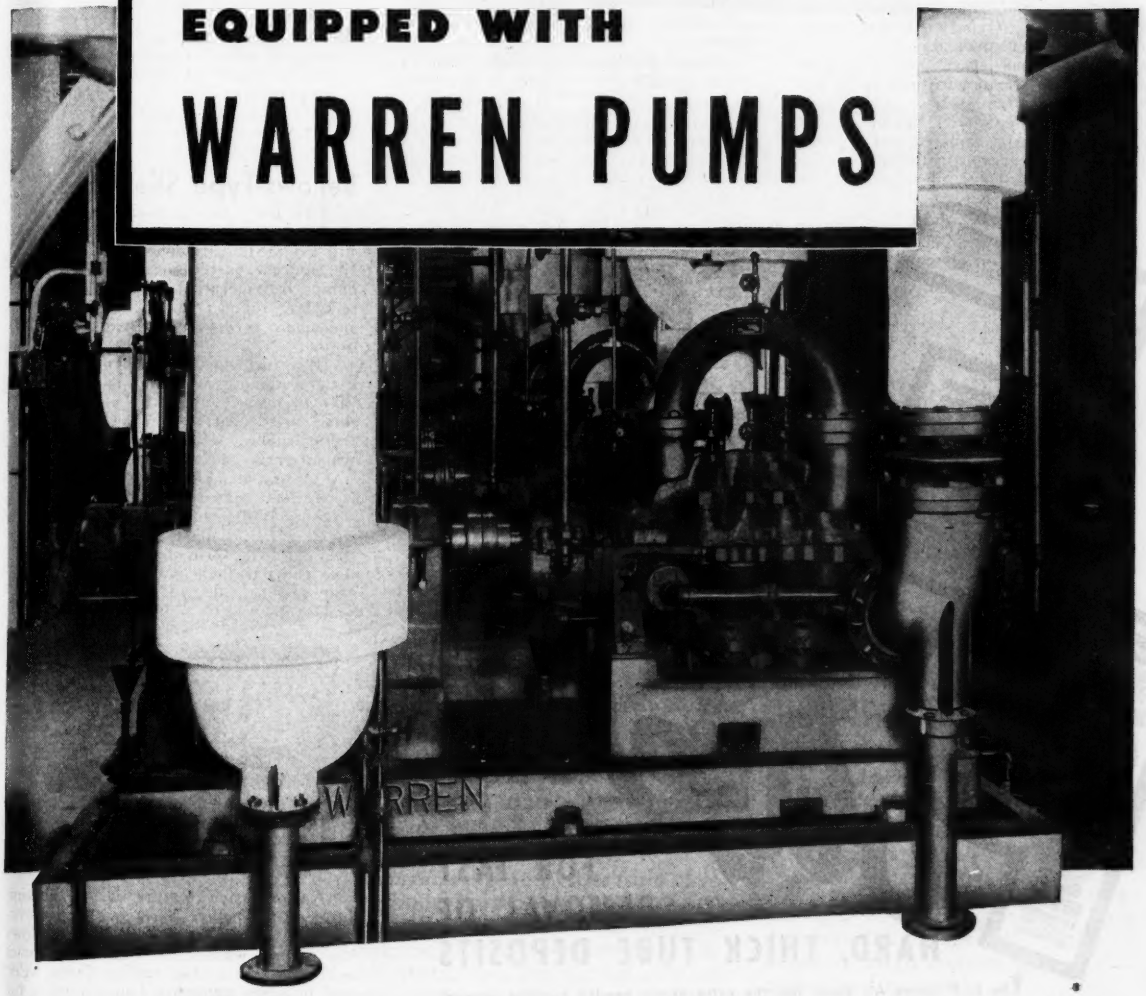
Each finned pipe is anchored at one end only, permitting pipes to expand and contract freely, independently of each other. Pipe alignment plates at extreme end, and also at center of all heaters with pipe lengths in excess of 6½ ft insure correct spacing, prevent sagging and assure uniform air flow.

Four sizes are available—20, 25, 30 and 35 in. in width across the pipes. Each size can be furnished with pipe lengths from 2 to 10 ft in 6 in. increments.

IMPORTANT

MAINE POWER PLANT EQUIPPED WITH

WARREN PUMPS



This modern power plant at Wiscasset, Maine, together with a similar plant at Bucksport, Maine, are two extremely important adjuncts of the Central Maine Power Company's system.

High speed, high pressure, Warren Centrifugal Boiler Feed Pumps assist these plants in helping to carry the load when water is low for development of hydro-electric power. The Warren Pump in the foreground is turbine driven; the next two in view are motor driven.

Ashore or afloat, Warren Pumps for Victory!

ARMY E NAVY

WARREN STEAM PUMP CO., INC., WARREN, MASSACHUSETTS

Synthetic Rubber Insulation

NUBUN, a new synthetic rubber latex insulation for power, lighting and communication cable has been developed by United States Rubber Co. as a result of war time developments in rubber technology. It will permit the design of new type of wire and cable with improved electrical and physical characteristics.

Made by the latex continuous dip method, Nubun is reported to have many advantages over ordinary wire where replacement and space are important factors. Fire alarm wire and cable police communication systems as well as other highly essential telephonic systems will be more easily replaced and serviced and will have greater resistance to destructive forces which cause circuit troubles with the use of this type of wire, it was stated.

Qualities of Nubun insulation include flexibility, impermeability to water, laminated construction, and perfect centering of the conductor to produce an insulated wire of maximum conductivity and minimum diameter. The synthetic insulation is said to be exceptionally homogeneous following vulcanization and has high electrical characteristics such as di-electric strength and insulation resistance.

Nubun insulation is made from a special modification of buna S synthetic rubber.

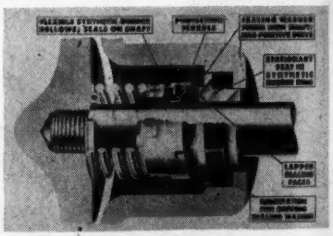
According to the rubber company's engineers, the following electrical and physical values have been established by laboratory tests:

Physical Tests	Before Aging	After 96 Hr Aging in Oxygen Bomb
Tensile Strength, lb	2500	2000
Elongation, in.	2–13	2–11
Set, in.	5/16	....
Electrical Tests		
Voltage breakdown after submersion in water at room temperature	650 v per mil	
Insulation resistance constant K after submersion in water at room temperature	54,000	
Specific Inductive Capacity at 70 C		
a. After one day in water.....	3.0	
b. After three days in water...	3.2	

Bellows-Type Shaft Seal

THE JOHN CRANE shaft seal is a new mechanical seal developed by Crane Packing Co., 1812 Cuyler Ave., Chicago 13, Ill., for use on the shafts of centrifugal pumps, refrigeration compressors, speed reducers, rotary pumps, agitator shafts and many other rotary sealing applications.

It is furnished as a complete sealing unit, ready for use, and is simple and easy to install. Basically, it consists of three major parts: (1) a flexible synthetic rubber bellows, the tail end of which grips and seals along the shaft; (2) a stationary floating seat, held in a synthetic rubber sealing ring; and (3) a positively-driven sealing washer, which turns with the shaft and is held against the stationary seat by spring pressure. The contacting faces of the washer and seat are lapped to form a leak-proof seal.



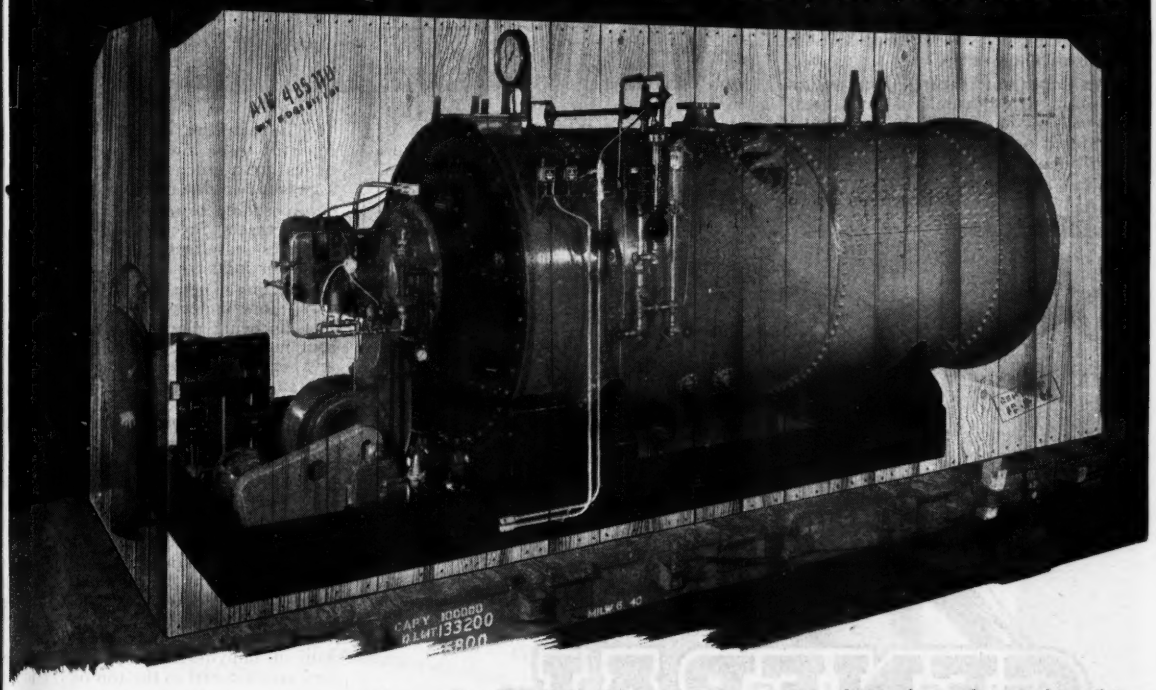
An exclusive feature is the flexing head of the bellows, which offers no resistance to the spring. This design allows the sealing washer to remain in contact with the seat as the sealing faces wear, and provides automatic compensation for shaft vibration and end-play. A protecting ferrule, fitting the shaft loosely, guides the flexing bellows head and prevents the synthetic rubber from contacting the shaft. There is no compression packing in the unit.

The stationary floating seat used in most installations is held in a synthetic rubber holding ring as illustrated. This construction permits easy insertion, prevents stress distortion of the sealing face during installation and allows the face to be lapped before insertion, thus eliminating the difficulties involved in lapping the face in the seal cavity.

The flexible bellows and holding ring are molded of special high-grade synthetic rubber stocks for maximum resistance to oil, hydrocarbons, refrigerants, water and antifreeze solutions. The other parts are made of materials best suited to give maximum service and to resist the chemical action of the fluids handled.

Extra Power
FOR FAST REMOVAL OF HARD, THICK TUBE DEPOSITS
The E. P. Series Air Motor has the extra power needed for fast removal of hard, heavy deposits even in large diameter tubes. Where hard spots stall ordinary motors, the E. P. has the extra torque to cut through. This feature saves time, labor and money in tube cleaning.
The reason for the high torque, extra power and low air consumption of the E. P. Motor lies in its exclusive valve design. Full use of air with minimum back pressure, leakage and friction, together with its six-cylinder construction, provide smooth power and prevent stalling.
Thomas C. Wilson, Inc. maintains a large engineering staff for consultation in solving difficult tube-cleaning problems. A bulletin describing the complete Wilson line will be sent on request.
MODERN TUBE CLEANERS FOR THE PROBLEMS OF TODAY.
wilson
THOMAS C. WILSON Inc.
21-11 44th AVENUE, LONG ISLAND CITY 1, NEW YORK

A STEAM PLANT *Package* OF UNEQUALLED SPEED —SIMPLICITY—AND LOW COST OF INSTALLATION



Only A Few Hours After Arrival This Cleaver-Brooks Steam Generator Can Be Placed In Full Operation.

INSTALLATION IS THIS SIMPLE and FAST

1. Connect to electric service.
2. Connect to oil supply.
3. Connect to water system.
4. Connect to steam lines.
5. Pipe to vent for burned gases.

Cleaver-Brooks oil-fired Steam Generators meet the needs of many industries and institutions for a compact, factory-assembled steam plant that can be quickly and easily installed... and will operate at high efficiency with a minimum of maintenance and attention.

Capacities range in 17 sizes from 15 to 500 boiler horsepower (700 to 17,000 lbs. steam per hour). Standard pressures range from 15 to 200 psi. Fully Automatic units for light oil only are available in sizes from 20 to 100 bhp. *Cleanliness* is one of the deciding advantages of Cleaver-Brooks Steam Generators for many users, including laundries, dry cleaners, food, processing, bottling, and dairy plants, hospitals and other institutions.

Fuel costs are unusually low because of the original and exclusive Cleaver-Brooks four-pass, down-draft construction of the boiler with its long fire travel and specially designed burners. High thermal efficiency — guaranteed over 80%.

The ability of the Cleaver-Brooks steam plants to raise steam quickly and maintain it in good volume and at steady pressures through the system recommends them to manufacturing and processing plants.

No stack. Simple vent from roof is sufficient. No footing construction. Channel iron frame sets on any floor of adequate weight carrying capacity. No refractory brick or insulation needed. No enclosure required. Operation is clean and dirt-free. No separate purchases. Standard equipment includes oil burner for light or heavy oil and full controls. Built by one company — one responsibility.

• • •

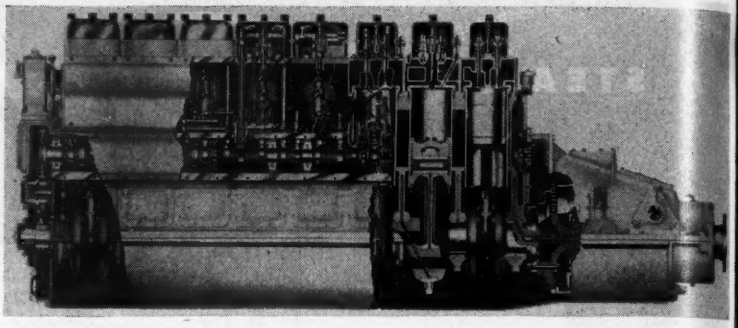
Write for complete information on Cleaver-Brooks Steam Generators for present use or future planning.

CLEAVER-BROOKS COMPANY, 5136 N. 33rd St., Milwaukee 9, Wisconsin

Cleaver-Brooks
STEAM GENERATORS

Medium Duty Sterling Diesel

ANNOUNCEMENT of a new line of Diesel engines has recently been made by the Sterling Engine Co. of Buffalo, N. Y., ranging from 250 hp to 650 hp. The new Sterling Viking Diesel embodies the latest and most modern features which have been produced out of the combined efforts of the Sterling engineers and the wide experience of Hans Bohuslav, vice president in charge of engineering.



An important feature of its design, according to Addison F. Vars, president of the company, is the fact that it provides a power plant with the same overall dimensions and same weight as gasoline engines of equivalent horsepower. This feature, it is stressed, is particularly notable because it means interchangeability with Sterling's Viking gasoline engine.

The quantity of fuel consumed is reported to be low. It uses two-thirds, or less, of a much lower price fuel than a gasoline engine of corresponding size.

According to ratings that the manufacturer sets, Sterling's line of Diesels becomes in effect heavy duty power units for industrial and marine use.

Sterling's new line of Diesel Vikings, forerunners of other lines of Diesels being planned, is composed of four models, a 6-cylinder supercharged and unsupercharged, and an 8-cylinder supercharged and unsupercharged. Horsepower ratings range from 250 to 650 and speed 900 to 1200 rpm. The weights of the various units range from a low of 7000 lb to a high of 13,000 lb.

The Viking Diesel is a 4-cycle, multiple cylinder, inline, trunk piston type engine, completely enclosed. The cast cylinder block is of single piece construction, containing the crankshaft main bearings at the lower surface with the wet cylinder sleeves inserted in the upper portion of the block. For easier handling, the cylinder heads are arranged individually for each cylinder and are fastened to the top of the block.

The cylinder heads are provided with four valves per cylinder, two intake and two exhaust. They are actuated by push rods and rocker arms from the camshaft which is located in the cylinder block and which is driven by gears from the free end of the counter balanced crankshaft.

The fuel injection system consists of individual injection pumps, one for each cylinder located close to each injection nozzle.

Other accessories are mounted in a compact accessory drive box attached to the cylinder block and driven by the timing gears. All accessories may be readily removed without dismantling the engine.

The bore and stroke for all models is 8 by 9 in., giving a displacement of 2714 cu in. for the 6-cylinder model, and 3619 cu in. for the 8-cylinder type. Starting is effected by two 32-v electric cranking motors situated on each side of the engine.

The lubrication system, which is dry sump, has two oil pumps, one to draw the oil from the sump beneath the engine and the other to supply forced feed lubrication to the bearings, including the wrist pin bearings.

Speed control is effected by means of a hydraulic governor having a wide range of speed regulations in the case of the Viking marine type engines, and having close speed regulations to meet all requirements in the case of the industrial and generator engine.

A battery charging generator and fuel oil supply pumps are provided.

RODA — High grade gas, by-product and steam coal from Wise County, Va., on the Interstate Railroad.

DENDRON — High grade gas, by-product, steam and domestic coal from Wise County, Va., on the Interstate Railroad.

STONEGA — High grade, high volatile steam and by-product coal from Wise County, Va., on the Interstate Railroad.

PREMIX STOKER — A laboratory controlled product blended to meet exacting stoker requirements. From Wise County, Va., on the Interstate Railroad.

COKE — Roda and Stonega from Wise County, Va., and Connellsville Coke from Pennsylvania.

CRITERION COAL — High grade gas, by-product, steam and domestic coal—Pittsburgh seam from Irwin Basin, Westmoreland County, Pennsylvania, on the Penna. Railroad.

CROZER — Genuine Third Vein Pocahontas from McDowell County, W. Va., on the Norfolk & Western Railroad.

Admiralty Coal — Genuine New River Smokeless, Beckley or Sewell seam from Raleigh County, W. Va., C. & O. and Virginian Railroads.

Old Kentucky — Hazard No. 4 and No. 7 steam and domestic coal from Wiscoal, Knott County, Kentucky, on the L. & N. Railroad.

GENCO — Steam and domestic coals from a number of producing districts.

ANTHRACITE—Hazle Brook Premium . . . Raven Run

Our personnel with the experience gained through long and varied marketing activity assures proper application of one of the above brands and effective servicing of any fuel requirement.

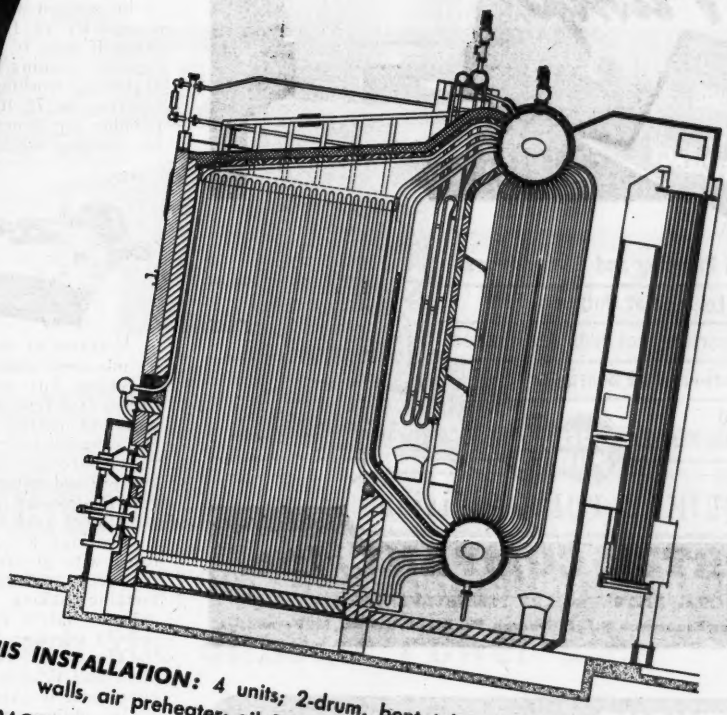
GENERAL COAL COMPANY

123 SOUTH BROAD STREET — PHILADELPHIA, PA.

BRANCHES:

BLUEFIELD, W. VA. — BOSTON — BUFFALO — CHARLESTON — CHARLOTTE, N. C.
CINCINNATI — DETROIT — NEW YORK — NORFOLK — PITTSBURGH

EDGE MOOR WATER TUBE BOILERS



THIS INSTALLATION: 4 units; 2-drum, bent tube, with superheater, water walls, air preheater; oil fired.

CAPACITY . . . . . 60,000 lbs. steam per hour.

DRUM PRESSURE . . . . . 500 lbs.

DEGREES OF SUPERHEAT 233

FINAL STEAM TEMPERATURE . . . . . 700° F.

These boilers are to be used in a refinery for the production of 100 octane gasoline.

Edge Moor Boilers are designed for any required capacity and up to 900 lbs. drum pressure. Complete steam generating units are available, including boilers, superheaters, water walls, economizers and air preheaters.

STEAM GENERATING EQUIPMENT

EDGE MOOR

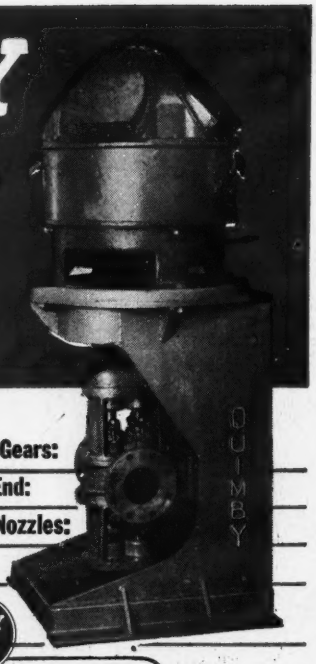
BRANCH OFFICES: NEW YORK 20, N. Y.: 30 ROCKEFELLER PLAZA
CHICAGO 2, ILL.: ONE NORTH LA SALLE STREET

MAIN OFFICE: EDGE MOOR, DELAWARE

QUIMBY

Rotex Pump

THESE 5 NEW FEATURES ASSURE LONGER LIFE, INCREASED EFFICIENCY



1. Double Helical Pumping and Timing Gears:
2. Timing Gears Located at Outboard End:
3. Improved Supporting Feet Ribbed to Nozzles:
4. Heavy Duty Anti-Friction Bearings:
5. Accessible and Interchangeable Parts:

QUIMBY PUMPS

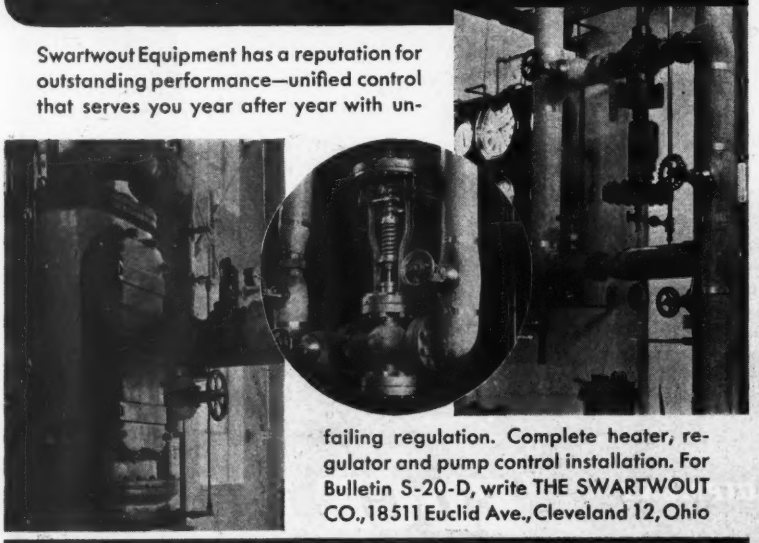
QUIMBY PUMP Division

H. N. PORTER COMPANY, Inc.

General Offices PITTSBURGH 22, PENNSYLVANIA

ALL SWARTWOUT control of your feed water is wise insurance against costly power failure

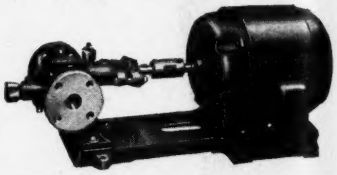
Swartwout Equipment has a reputation for outstanding performance—unified control that serves you year after year with unfailing regulation. Complete heater, regulator and pump control installation. For Bulletin S-20-D, write THE SWARTWOUT CO., 18511 Euclid Ave., Cleveland 12, Ohio



Swartwout POWER PLANT EQUIPMENT

Goulds Rotary Pumps

A NEW LINE of rotary pumps of the double helical or herringbone gear type which are designed to handle liquids which possess inherent lubricating qualities, has just been announced by Goulds Pumps, Inc. of Seneca Falls, N. Y. The pumps are available in ten sizes ranging from that with ½ in. suction and discharge and with a capacity of from one to one and one-half gpm to the 2½ in. type with capacity ranging from 50 to 75 gpm. Maximum working pressure in all sizes is given as 75 lb. All sizes are obtainable for direct drive through flexible coupling or for belt drive.



Features of the new rotary pumps include their simplicity of construction involving but two moving parts, a split bolted type gland, renewable bearings and built-in relief valve. All are exceptionally quiet in operation.

The rotors are accurately bored and pressed onto the shaft. The driven gear is of bronze while the driving gear is of steel held by a key.

Bearings are of high lead bronze fitted with grease lubricators. The extra deep stuffing box is fitted with metallic packing. The bronze gland is split in halves for easy removal and is held together by two fitted bolts.

The relief valve of the stainless steel ball type is built into the pump cover and is externally adjustable.

In addition to the standard fitted type all pumps are also available with all parts of iron or steel or in all bronze construction.

MANUFACTURERS' NEWS

Tube Turns, Louisville, Kentucky, has reopened its Los Angeles office in the Van Nuys Building with James H. Withers in charge.

Whiting Corp., Harvey, Ill., has announced the appointment of Cardinal Supply & Mfg. Co., Omaha, Neb., as sales representative in that territory.

General Electric Co. has announced the appointment of three sales managers for the company's motor division and integral-horsepower, alternating-current motor section. Elliott Harrington will be located in Schenectady, J. T. Farrell also Schenectady, and D. A. Yates at Lynn, Mass.

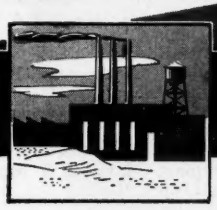
Wheelco Instruments Co., Chicago, Ill., has announced that Charles L. Saunders former vice president of Minneapolis-Honeywell Regulator Co., has recently resigned as branch chief of the WPB Office of Civilian Requirements to become vice president of Wheelco Instruments Co.

Bituminous Coal Research, Inc., has recently appointed Elmer R. Kaiser as assistant director of research for the bituminous coal industry's technical program. Mr. Kaiser will be located in Room 719 Oliver Building, Pittsburg, Pa., where Dr. H. J. Rose, the recently appointed director of research, has already established headquarters.

Power Plants

DESIGNED...

ENGINEERED...



CONSTRUCTED...

from the Fundamental Prime Mover through the ultimate Power use.

• RECONVERSION OF WAR INDUSTRIES •

Geared to wartime operation, industry must plan reconversion to peacetime production. It is highly essential for economic reasons that plants be ready with no time loss involved when the change-over is required.

In reconversion, *power* is all-important. Power planning should start now. J. F. Pritchard and Company power engineers are thoroughly equipped to analyze your power problems—no matter how complex—and place before you a plan to assure ample power for your reconversion plans. J. F. Pritchard and Company, *Power Division*, Fidelity Building, Kansas City, Missouri.

KANSAS CITY
TULSA
CHICAGO

Pritchard

HOUSTON
NEW YORK
PITTSBURGH

ENGINEERS AND CONSTRUCTORS
FOR THE CHEMICAL • PETROLEUM • GAS AND POWER INDUSTRIES
Manufacturers of Mechanical and Atmospheric Cooling Towers

We Didn't Want to Make Strainers

BUT we needed them for use with Yarway Steam Equipment and couldn't find any to suit us.

So we designed the *YARWAY Strainer.*

Apparently a lot of other people were having "Strainer trouble" because, without a line of advertising, the Yarway Strainers *purchased* in a few years now number *many thousands.*

Why don't you look into this better Strainer for your money? Buy one from your supply house (over 100 Mill Supply Houses now have them).

See its protection against corrosion—*cadmium plating inside and out.*

Examine its *high grade Monel woven wire screen* that stops dirt—lets condensate or other fluids flow freely.

Notice the removeable blow-off bushing. Screen and bushing come out together—go back together, *automatically aligning.*

Six standard sizes from ½" to 2" for pressures to 600 lb.

See your Mill Supply House or write for Bulletin S-200

YARNALL-WARING COMPANY
114 Mermaid Ave. PHILADELPHIA 18, PA.

YARWAY STRAINERS

J. O. Ross Engineering Corp., Boston, Mass., announced the election of S. W. Fletcher as president of the company whose headquarters are in New York City. A. E. Montgomery will continue as vice president with headquarters in Chicago. Other officers of the corporation being, Vice presidents—H. G. Rappolt and F. W. Partsch; Treasurer—J. A. Ronder; Secretary—R. W. Grott.

Haynes Stellite Co., a unit of Union Carbide and Carbon Corp. has announced that E. E. LeVan has been elected president of the company to succeed the late Francis P. Gormely. Mr. LeVan will continue to make his headquarters at Kokomo, Ind. where the general office and plant of the Stellite Co. are located. He had a leading part in making available to industry the advantages of chromium-cobalt-tungsten alloys, the development of which has made rapid progress during the past few years. He has been associated with the company since 1922.

J. B. MacNeill, manager of the Switchgear and Control Division of the Westinghouse Electric & Mfg. Co., has announced the following additions to the staff: Maurice H. Hobbs to manage the Engineering Department of the Division; Charles P. West, manager of Switchboard Engineering; and Wilbur C. Fulton, section engineer in Switchboard Engineering.

Manning, Maxwell & Moore, Inc., of Bridgeport, Conn., has announced the appointment of E. M. Dunlap as Manager of Distributor Sales. He will take over complete charge of the distribution of the company's products manufactured in Boston and Bridgeport works. The company also announces the appointment of Rudolf Beck as Chief Engineer of the American Instrument Division. Other recent personnel changes in the corporation are the appointment of Albert W. Coleman to the position of Sales Manager, Paul M. Rolli to Pacific Coast District Manager, L. E. Gebhart to Mid-Atlantic District Manager, Charles Stephan to Manager of the Electro-Mechanical Division, Lee P. Stillman to Manager of the Tulsa Products Division, and James O'Connor to Sales Engineer with the Ashcroft Gauge Division.

Yeomans Brothers Co. has recently appointed the Engineering Equipment Co., Cincinnati, Ohio, as representative in that area which includes part of Indiana and northern Kentucky in addition to south western Ohio. F. L. Holliday heads the Engineering Equipment Co.

Todd Shipyards Corp., which has been managing agent for the Navy of the Los Angeles Shipbuilding and Dry Dock Corp. since last December, took over operation of the yard on July 10 as an independent contractor on a cost-plus-fixed-fee basis.

Announcement is made by Cutler-Hammer, Inc., Milwaukee, Wis., of the opening of a drive-in warehouse at 1200 Walnut St., Cincinnati, Ohio. At present Cutler-Hammer maintains a district sales office at Central Parkway and Walnut St. in Cincinnati. Both the district office and the new drive-in warehouse will be under the management of E. C. Bolton. A complete stock of Cutler-Hammer electrical controllers for industrial, commercial and domestic needs will be carried at the drive-in warehouse.

AJAX *Spiral Wound* METAL and ASBESTOS GASKETS

ENGINEERED TO WITHSTAND PRESSURES FROM 10 PSI UP

AJAX Gaskets are made to a rigid standard . . . which is your guarantee of consistent operating efficiency under any required service condition.

EVERY AJAX GASKET MEETS THESE ESSENTIAL REQUIREMENTS:

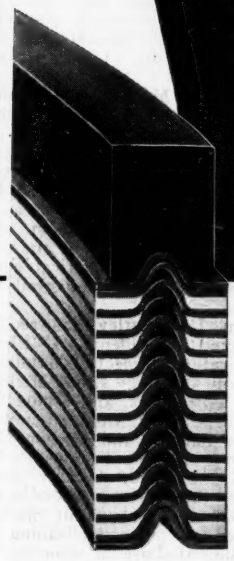
1. Positive, leak-proof seal
2. Easy installation
3. Freedom from trouble in service
4. Delivery

There is an AJAX Gasket for every connection in your plant engineered to this standard. Here are simple construction facts:

A single strip of metal is preformed into a U-shaped groove and wound spirally from the inside to the outside. Two parallel thicknesses of UGASCO Asbestos filler are inserted between each metal ply. A functionally important air space between each of these thicknesses of asbestos makes AJAX "the gasket that breathes."*

Standard AJAX Gaskets cover pressure ranges from 10 psi and up. Gaskets for varying pressure conditions are wound within a set OD and ID.

AJAX Spiral Wound Gaskets are the product of years of specialized experience in "gasket-engineering." Send your requirements and write for data sheets and samples today



*THE STORY BEHIND *"THE GASKET THAT BREATHES"*

Note on this cutaway drawing, the small air space under each U-groove in the metal ply.

There are twin strips of asbestos filler between each spiral thickness in the AJAX Gasket which cannot meet in the center under the wedge-like groove. Therefore a "breather-space" is preserved in the heart of the gasket which assures its automatic reaction to mechanical compression, to internal pressure variation, and to temperature changes.

The AJAX Gasket expands and contracts — "breathes" — with changing pressure conditions—and retains the positive, secure seal you require at all times.

A FEW OF THE SHAPES AND TYPES AVAILABLE

A WORKING MANUAL OF AJAX GASKETS

CATALOG 202

COMPLETE DATA
Specifications—Prices
SEND FOR YOUR COPY

In Texas and Louisiana, AJAX Gaskets are known as STERL-TALLIC and are distributed by Sterling Packing and Gasket Company, Houston, Texas.

U. S. GASKET CO.

1596 PIERCE STREET, CAMDEN, NEW JERSEY

Keep these vital tools ready for action

Suppose an emergency required you to open one of your boilers, condensers or other tubular units today. Would you be able to take advantage of this condition by descaling tubes while the unit is down? How long is it since you looked over your tube cleaners? Why not do it now, while you think of it? They may need adjustment, repair or parts replacement. You'll have to use your tube cleaners sooner or later, perhaps sooner than you expect. So why risk tieing up the unit on account of tube cleaners? Get them ready for immediate action now.

The ROTO Company

Division of Elliott Company

145 Sussex Avenue

Newark 1, N. J.

BACK THE ATTACK WITH WAR BONDS

The Briggs Clarifier Co., Washington, D. C., announces the following zone managers and distributors recently appointed. Thomas W. McKinley, Southeastern Zone Manager with headquarters at Atlanta, Ga.; Donn Murphy, Southwestern Zone Manager, headquarters in Dallas, Texas; A. H. Martin, Western Zone Manager, headquarters in San Francisco, Calif.; W. P. Childs Machinery Co., distributor at Atlanta, Ga.; Pate Supply So., distributor at Birmingham, Ala.; and Sullivan-Mears Co., distributor at Kansas City, Mo.

MANUFACTURERS' PERSONALS

Walter P. Konrad has been promoted from the Phosphate sales department of the Monsanto Co., St. Louis, Mo., to branch manager of the Phosphate sales division in Chicago.

Stanley W. MacKenzie succeeds George M. Tisdale as director of purchases of U. S. Rubber Co. Mr. Tisdale has recently been elected vice president and member of the executive committee of the company.

Frank E. Bodine, who since 1941 has been manager of the Salt Lake City office of Westinghouse Electric & Mfg. Co., has been transferred to San Francisco as manager of the company's office in that city. In his new position Mr. Bodine will take over the San Francisco managerial duties heretofore handled by Mr. Dostal who is now in charge of the company's business in the Pacific Coast District.

Howard C. Herbert has been appointed field engineer for steel mills in the Pittsburgh district by the Allis-Chalmers Mfg. Co. Mr. Herbert was formerly with the I-T-E Circuit Breaker Co.

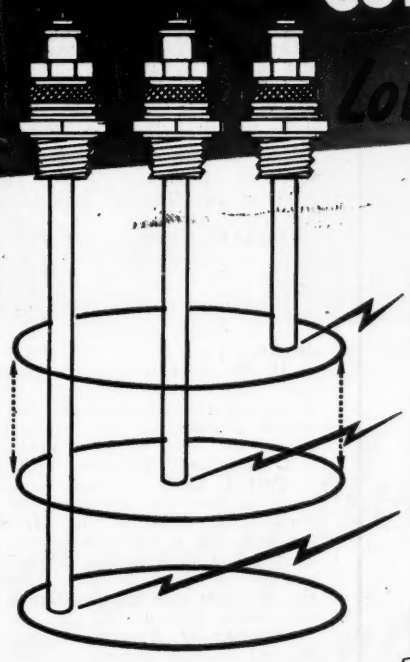
Donald W. McGill has recently been appointed manager of the Machinery Electrification Section of the Industrial Department of Westinghouse Electric & Mfg. Co., to succeed L. F. A. Mitchell who has returned to the Canadian Westinghouse Co. as assistant to the vice president. Mr. McGill will be in charge of the company's application of electrical equipment and controls for industrial machinery.

William J. Priestley has recently been elected President of Electro Metallurgical Co., Electro Metallurgical Co. of Canada, Ltd., Michigan Northern Power Co., and Union Carbide Co. of Canada, Ltd., all units of the Union Carbide and Carbon Corp. He succeeds the late Francis P. Gormely. Mr. Priestley became associated with the Electro Metallurgical Co. in 1923 and throughout his business career has taken the leading part in extending the use of stainless and alloy steels.

Carl Christiansen has recently been appointed to the Engineering Staff of John C. Dolph Co., Newark, N. Y. He comes to his new position after service with the Pan American Lines and the Curtiss-Wright Corp.

C. W. La Pierre has been appointed assistant engineer at the General Electric Co.'s general engineering laboratory according to an announcement by Everett S. Lee. Mr. La Pierre has been in charge of the electro-mechanical section of the laboratory since 1936.

NOW -- Completely Automatic Boiler Feedwater Control at Low Cost



At normal high-water level, Fireye shuts off boiler feedwater pump.

At normal low-water level, Fireye starts feedwater pump.

At danger level, Fireye cuts off fuel and sounds alarm.

. . . with fireye the modern electronic system

The Fireye method of boiler feedwater regulation is floatless, maintenance-free—*electronic*—the modern word for "the best in automatic control." Completely eliminated are troublesome mechanical devices subject always to wear and maintenance—failure and replacement.

Metal probes—electronic fingers—"feel" levels as rising or falling water makes and breaks probe-tip contact, relaying to Fireye a minute electrical current. Amplified within the electronic control, this current actuates heavy-duty switches to start and stop the feedwater pump as required and to provide instantaneous alarm at a low-water danger point.

Write today for full details on how Fireye Electronic Control can be applied to your boilers. Ask for Catalog 51A.

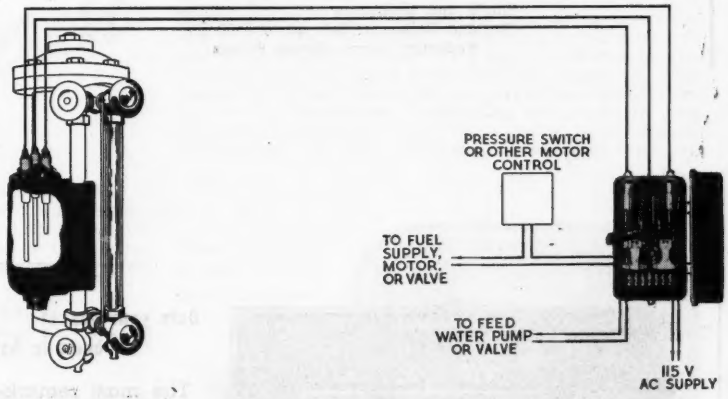
★ ★ ★

FIREYE PHOTOELECTRIC FLAME FAILURE SAFEGUARD eliminates explosion hazards in oil or pulverized coal burners. Write for Catalog 50A.

OPERATION

Fireye Probe Fitting—mounted parallel to the water column and wired to Fireye Electronic Control—incorporates three probes marking boiler feedwater pump on and off levels and a low water danger point.

When water falls below the middle probe, Fireye closes the pump control circuit and water is automatically fed to the boiler until the level reaches the top probe. Fireye then opens the circuit, stopping the pump until the water again drops below the middle probe. Should the level at any time fall below the lowest, or safety probe, Fireye instantly cuts off the fuel supply and sounds an alarm.



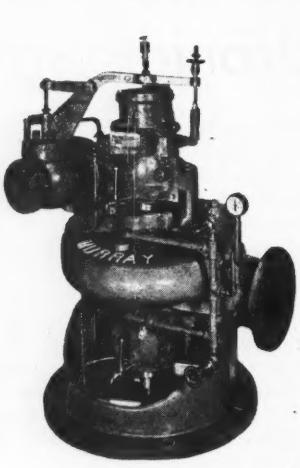
COMBUSTION CONTROL CORPORATION

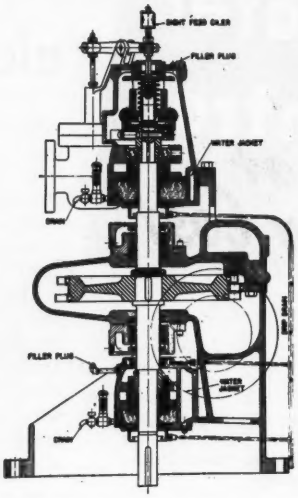
Cambridge 42, Mass. • District Offices in all Principal Cities

fireye **electronic**

BOILER FEEDWATER CONTROL

MURRAY
VERTICAL STEAM TURBINES



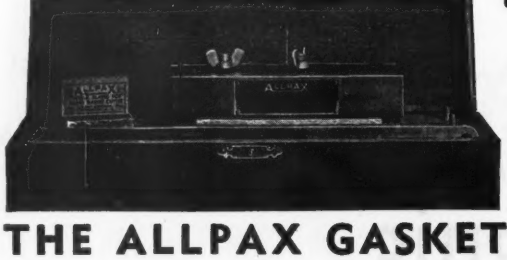


To drive vertical shaft pumps MURRAY can furnish either direct-connected or geared turbines for steam conditions up to 600 pounds initial pressure, 750 degrees F. total temperature and 50 pounds back pressure, and for ratings up to 200 HP.

Following the same quality construction furnished on horizontal turbines, standard equipment includes mechanical constant speed governor on the main shaft, bolt type emergency overspeed governor, carbon ring glands, babbitt lined sleeve type bearings pressure lubricated, and ball type thrust bearing arranged to carry up and down thrust.

MURRAY also builds:

Single and multistage horizontal turbines
Turbine Generator Sets up to 2500 KW
Reduction gears—Steam Boilers



Cuts your gasket costs in half

The most remarkable tool ever invented

Write for booklet

THE ALLPAX GASKET CUTTER

Manufactured by

THE ALLPAX COMPANY, INC.

Distributors everywhere — *Mamaroneck, N. Y.*

M. J. Boho has been appointed assistant general manager of sales by the Hagan Corp. of Pittsburgh, Pa. Mr. Boho, who joined the corporation in 1936, will assist D. J. Erikson, vice president of the corporation. Prior to joining Hagan, Mr. Boho was associated with the Bailey Meter Co. and the Potomac Electric Co.

Joseph S. Bennett, recently Manager of Sales of the American Engineering Co., Philadelphia, has been elected Vice President. Mr. Bennett has been connected with A-E-CO successively as draftsman, Assistant Construction Engineer, Assistant Mechanical Engineer and Manager of Sales.

The Executive Committee of the Board of Directors of the American Locomotive Co. today announced the following appointments: Perry T. Egbert, vice-president in charge of Diesel Locomotive Sales; William S. Morris, vice-president in charge of Steam Locomotve and Divisional Sales, and James D. Vaughan, comptroller.

Clarence L. Wanamaker has been named general manager of the munitions division of the United States Rubber Co. to succeed Ernest G. Brown, recently chosen general manager of mechanical goods, general products and "Lastex" yarn and rubber thread divisions.

David M. Kelley has been appointed to the engineering staff of the John C. Dolph Co., Newark, N. J., in charge of the Industrial Service Division. He was formerly associated with the I. T. E. Circuit Breaker Co. of Philadelphia.

H. O. Teeple, chemical engineer, has joined the Technical Service Group of the Development and Research Division of The International Nickel Co., Inc., at New York. He will specialize in corrosion problems.

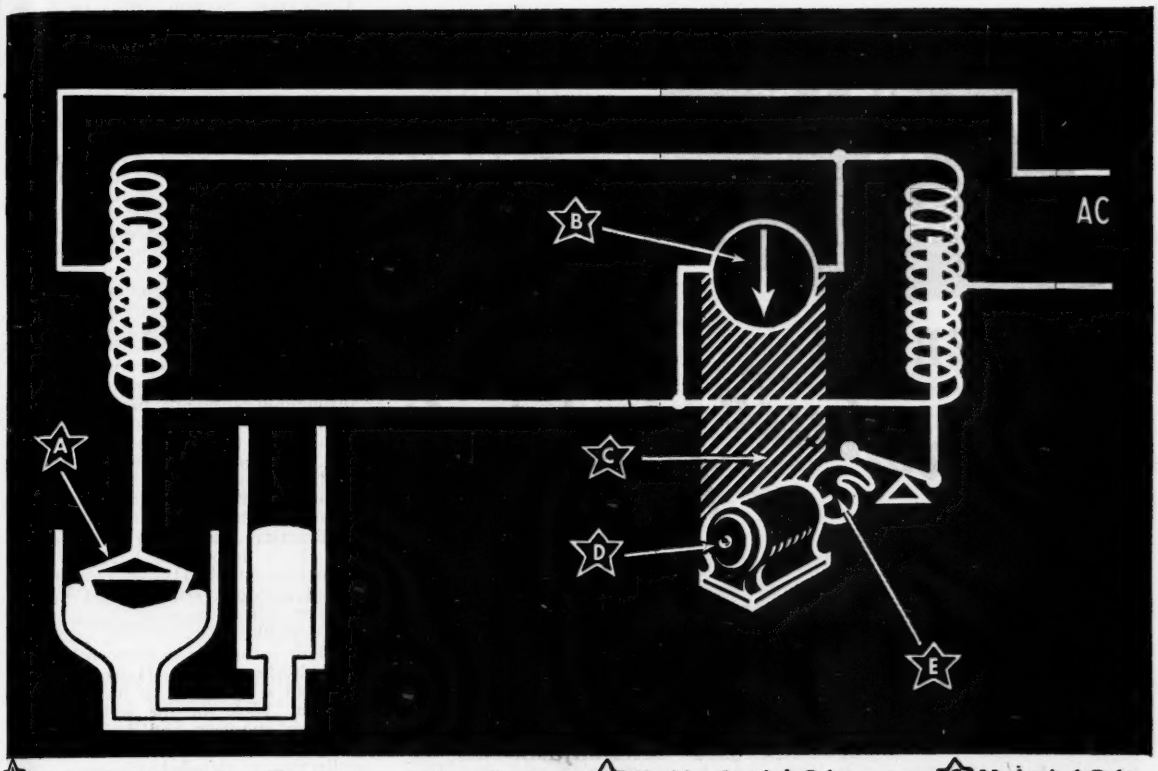
Carl J. Dinic has been appointed Assistant to the President of the American Locomotive Co. Mr. Dinic for five and a half years was with United States Steel Corp. of Delaware, and previously he served as an executive assistant with Eastern Gas & Fuel Associates, Boston.

Norman W. Stirling has been appointed Manager of Sales of the Whitlock Mfg. Co., Hartford, Conn. Mr. Stirling was formerly with the M. W. Kellogg Co.

NEW ENGINEERING BOOKS

Report Issued on Use of Cyclohexylamine

THE U. S. BUREAU OF MINES, Department of the Interior, announces the publication of an interim report describing research in the use of cyclohexylamine, one of the principal chemicals employed in neutralizing destructive carbonic acid formed in the condensed steam. The title of this publication is "Observations on the Use of Cyclohexylamine in Steam-Heating Systems," and was prepared by A. A. Berk. The publication is designated as Report of Investigations 3754, and may be obtained without charge from the



A Friction-free Transmitter. Float rests on surface of mercury. B Sensitive Jeweled Galvanometer. C Mechanical Relay. D Powerful Auxiliary Motor. E Calibrated Cam insures uniform accuracy.

Study this diagram

Movement of the float (indicating difference in rate of flow) is detected by the sensitive galvanometer (B) which causes the mechanical relay (C) to actuate the powerful auxiliary motor (D) bringing the receiver core to the same position as the transmitter core, and moving pen arm, indicator and integrator to record the change in flow.

No other flow meter has this simple, friction-free principle. It follows that for matchless ACCURACY you need only specify the Cochrane Flow Meter.

It explains the matchless ACCURACY of the Cochrane Flow Meter . . .

We print this diagram as large as we can get it for a very good reason. Once you understand the basic principle of the Cochrane Friction-Free Electric Flow Meter, the secret of its matchless Accuracy becomes plain. Because flow meter accuracy is attained first, by eliminating friction at the manometer and second, by applying ample power to overcome inherent friction in the receiver. Note how friction has been eliminated in the Cochrane manometer. The float rests on the surface of the mercury in the high pressure leg of the manometer, positioning the magnetic core between two reactance coils. There are no stuffing boxes, no bearings, no electric contacts, no solenoid reactions.

•

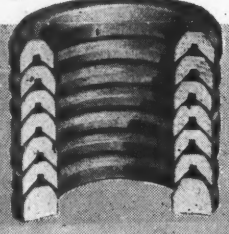
Write for a copy of Publication 3010 "Flow Meters by Cochrane."

COCHRANE CORPORATION
3123 N. 17th ST., PHILADELPHIA 32, PA.

COCHRANE

For STEAM · WATER
AIR · GAS · HOT or
COLD OILS · SOLVENTS

CHESTERTON
Parachute Packing

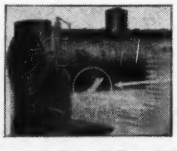


The sectional view at left shows you how Chesterton Parachute Packing is molded in construction —requires no backing-off of gland or bothersome after-adjustments —keeps a tight seal and reduces friction to a minimum—simplifies power equipment maintenance . . . Chesterton Packings are sold in all principal cities by Factory-Trained Distributors. . . . Write today for Catalog 22-E. It describes the complete Chesterton packing line, includes useful Packing Selector chart, answers many packing questions.

FULLY AUTOMATIC
MOLDED CONSTRUCTION
NO BACKING-OFF GLAND
KEEPS TIGHT SEAL

A. W. CHESTERTON CO.
64 INDIA STREET,
BOSTON, MASS.
Factories: Melrose, Mass., Chicago, Ill.

"Boiler Repairs Reduced 75%"
writes user of NATIONAL GIRTH SEAM PROTECTOR



We have been using the National Girth Seam Protector for several years and they certainly do the job. . . . Have reduced our boiler repairs at least 75% since using these protectors, one of the best investments we ever made.
Von Platen-Fox Co.
Iron Mountain, Mich.

You, too, will find the National Girth Seam Protector saves trouble and money by preventing leaks and fire-cracking on new or old seams in boilers. Sections consist of wedge nut, cap screw metal lug and refractory covering; are easily attached. We can make immediate deliveries. Send for descriptive bulletin.

NATIONAL BOILER PROTECTOR CO., 740 REIBOLD BLDG., DAYTON, OHIO

Publications Section, Office of Minerals Reports, Bureau of Mines, Department of the Interior, Washington 25, D. C.

Public Rural Electrification, by Frederick William Muller, copyright 1944, 6 by 9 in., 183 pages. Published by the American Council on Public Affairs, 2153 Florida Ave., Washington, D. C. Price $3.00 for cloth edition, $2.50 for paper edition.

The author has endeavored to picture the rural electrification program as it was immediately before the present war. In various chapters he has described the development of rural electrification, the rural electrification administration, the rural electric cooperative, the control of operations, the planning program and possible future developments. The book is factual throughout although the author does take occasion to express his opinions on policies and the reactions of those who use REA services. It will make good reading for those who wish to inform themselves regarding electrical development in the rural districts.

Practical Design For Arc Welding, Vol. I, by Robert E. Kinkead, copyright 1944, 8¾ by 11½ in., cloth bound, 100 design plates. Published by The Hobart Brothers Co., Troy, Ohio. Price $3.50.

This is the first of three volumes to be published by The Hobart Brothers Co. and is designed to be a practical working book for the welder, manufacturer, engineer, and designer working with welding equipment. It is a collection of detailed drawings showing how tubing, plate, sheet, standard steel sections, angles, and bars can be used to fabricate better, stronger, improved appearing products with arc welding and do it at substantially lower cost. Opposite each design plate is a conveniently arranged work sheet that will aid in determining costs. An aid to the understanding of welding drawings is the description of welding symbols which are given in the front of the book. Included is complete index of the plates and the drawings are of a readily usable size for shop practice. This is in no sense a text book but rather a collecton of drawings of machine parts illustrating how welding can be used in their construction. It should prove very helpful to the machine builder or repair man.

The Welding Encyclopedia 11th Edition. Edited by L. B. Mackenzie and others, re-edited by T. B. Jefferson. Copyright 1943, 6 by 9 in., 976 pages, simulated leather binding. The Welding Engineer Publishing Co. 506 So. Wabash Ave., Chicago 5, Ill. Price $6.00.

The first edition of this comprehensive encylopedia was published in 1921 since which time revised editons have been printed biennally with a total distribution of over 150,000 copies. Due to the gigantic strides that have been made in the welding industry during the past few years many changes in and additions to the information contained in former editions have been made which brings the present volume up-to-date in the art and practice of welding as applied in modern industry. The subjects are arranged alphabetically with frequent cross references to facilitate thorough covering of a subject. The five parts into which this edition is arranged come under the followng headings: An Encyclopedia of Welding; Appendixes; A Dictionary

HOW'S YOUR VOLTAGE?

You can often iron out difficulties by regulating voltage--and SAVE

New England lab cuts testing time

This laboratory, testing electronic tubes and communications equipment, was getting uncertain test results because of a fluctuating incoming line voltage. It was necessary to repeat some tests over and over to assure accuracy. G-E engineers suggested installing three 3.6-kva, 120-volt automatic induction regulators. These regulators now furnish the exact voltage required for each test, and hold it constant throughout the test. Over-all testing time has been cut in two.

Aircraft plant saves—and speeds inspection

A midwestern manufacturer X-rays all propellors before releasing them for duty, to make sure that they are perfect. Considerable time was being lost because of fluctuations in the voltage applied to the X-ray machine. Underexposure or overexposure of X-ray film was the rule rather than the exception. Numerous "retakes" were necessary. This problem was ironed out with an automatic G-E 2.4-kva, 240-volt, induction regulator. Not only was time saved and production increased but the savings in X-ray film alone paid for the regulator in three months.

Western power company saves critical material

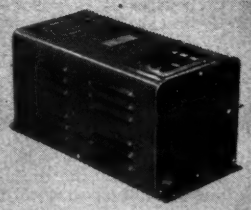
A western radio station experienced trouble because varying loads caused voltage fluctuations on the feeder supplying the station with 240-volt, three-wire, single-phase service. For the power company serving this area to install an *independent* feeder, would have required a large amount of critical material, and would have been difficult because of its effect on the station's elaborate antenna counterpoise. This problem was solved by installing a 2.4-kva G-E induction regulator on the *existing* feeder. Voltage regulation is now reported excellent.

What is your problem?

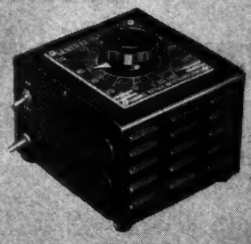
Pepless motors, poor lighting, uncertain test results, and production slumps are often the result of poor voltage. Whether you need voltage control for an electronic tube or a power shovel, there's a simple, economical G-E device for the job. Ask your G-E representative for further information. *General Electric Company, Schenectady 5, N. Y.*

Motor-operated regulator typical of sizes 3.6 kva and smaller. For automatic operation, control panel is furnished separately.

OTHER G-E AIDS TO BETTER VOLTAGE



VOLTAGE STABILIZER—Automatically provides a constant 115-volt supply to a given load, on circuits varying from 95 to 130 volts. Ratings from 50 to 5000 va. Ideal for precision laboratory or manufacturing processes, or built into such equipment as radio transmitters.



VARIABLE-VOLTAGE AUTO-TRANSFORMER—Provides smooth, adjustable control of voltage, current, light, temperature, power, and speed at a turn of the dial. Ratings from 243 to 810 va. Ideal for use in factories, laboratories, and assembled with other equipment.

TYPE D TRANSFORMER—For insulating lighting circuits, reducing light flicker, boosting or stepping down voltage for the most economical operation of motors, welding equipment, etc. Ratings up to 100 kva, 600 volts.

THE RIGHT VOLTAGE AT THE RIGHT PLACE DOES THE JOB **BETTER**

GENERAL ELECTRIC

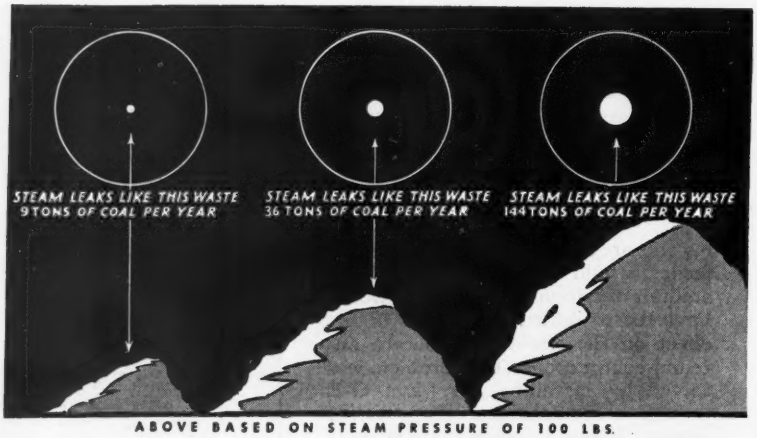
of Trade Names; The Welding Industry Buyers' Manual; and Index. In every respect the volume is designed to be helpful to the man confronted with the problems of joining metals by some process of welding and is so comprehensive as to include many detailed directions for carrying out specific welding jobs.

Principles of Powder Metallurgy, by Franz Skaupy, copyright 1944, 6 by 9 in., 80 pages, hard cloth binding. Published by the Philosophical Library, Inc., 15 East 40th St., New York, N. Y. Price, $3.00.

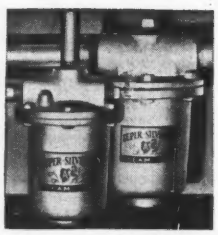
In his preface the author calls attention to the fact that most metal objects met in ordinary life or in technology, have passed through a fusion or melting process. Among recent developments, however, is a method for producing metal objects which consists in changing metal powder into compact metal bodies by a process of caking or cohesion. Recently this method has received important application in production of particularly hard metal. The author terms this new field "Metal Ceramics", and in his book deals with the many problems encountered under the section headings of Metal Powders, and Production and Properties of Ceramic Metal Parts. A special part is devoted to a discussion of ceramics of wolfram, molybdenum, tantalum, and other metals, and ceramics of hard metals. The reader of this book will find it highly interesting and no more technical than seems necessary for an understanding of so new a process of producing metal structures.

Speaking of FUEL CONSERVATION

have you checked your steam traps lately?


STEAM LEAKS LIKE THIS WASTE
9 TONS OF COAL PER YEAR
STEAM LEAKS LIKE THIS WASTE
36 TONS OF COAL PER YEAR
STEAM LEAKS LIKE THIS WASTE
144 TONS OF COAL PER YEAR

ABOVE BASED ON STEAM PRESSURE OF 100 LBS.



Photograph shows Super-Silvertop Steam Traps piped straight-in-line or as an elbow. Inspected without removing from the line.

The National Fuel Efficiency Section of the Bureau of Mines asks us to conserve fuel to win the war.

The above chart shows how leaks waste fuel . . . Old obsolete steam traps are a source of leaks.

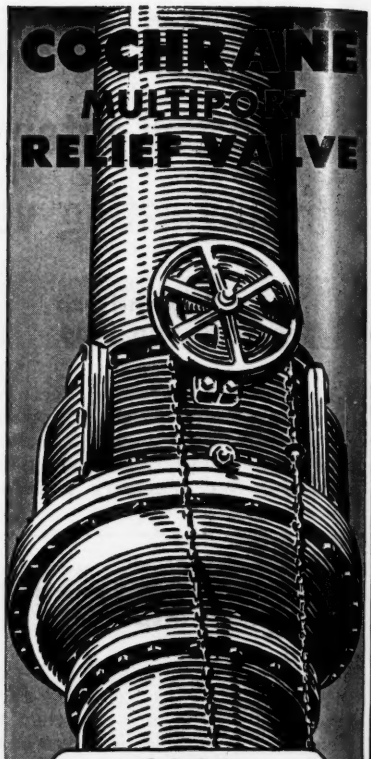
Right now inspect your traps. If you need new traps, install fuel-saving ANDERSON SUPER-SILVERTOPS.

Send for the book, "How to Choose a Steam Trap," giving complete information.

THE V. D. ANDERSON CO.
1939 W. 96th Street • Cleveland 2, Ohio

Super-Silvertop
STEAM TRAPS

COCHRANE
MULTIPORT
RELIEF VALVE



The **SAFE** Valve

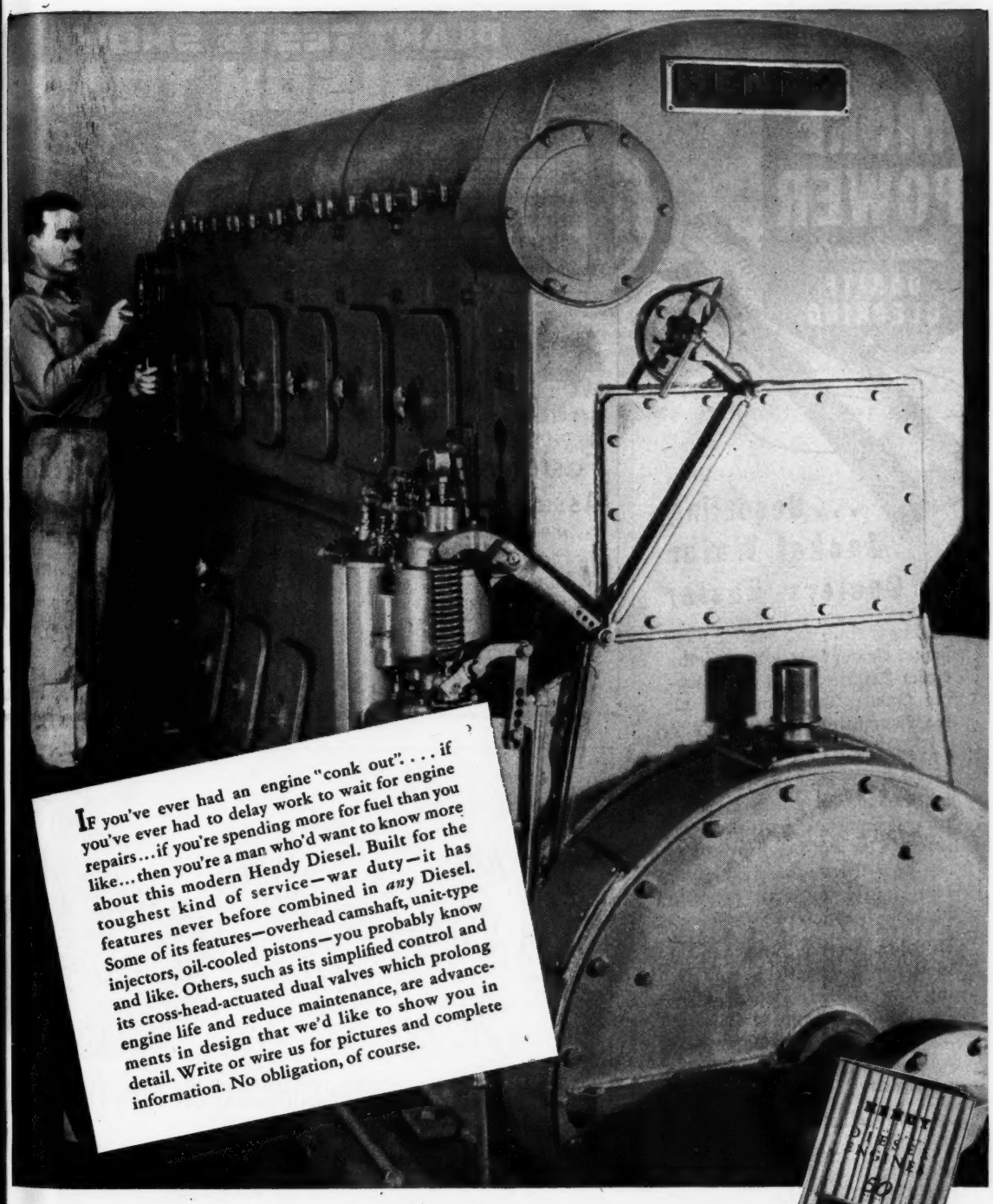
For BACK PRESSURE ATMOSPHERIC RELIEF AND FLOW OR CHECK VALVE SERVICE

Danger from sticking, jamming or freezing is eliminated by the multiplicity of valve disks instead of one large disk.

Chattering and pounding are also absent because the valve disks are light in weight with short travel and are further steadied by individual cushion chambers. Pressure is easily adjusted by varying the compression of the valve springs, which is done by shifting the pressure plate by means of a hand wheel, chain or motor.

Write for a copy of Publication 2870

COCHRANE CORP.
3123 N. 17th St.
Philadelphia, Pa.



IF you've ever had an engine "conk out". . . . if you've ever had to delay work to wait for engine repairs... if you're spending more for fuel than you like... then you're a man who'd want to know more about this modern Hendy Diesel. Built for the toughest kind of service—war duty—it has features never before combined in *any* Diesel. Some of its features—overhead camshaft, unit-type injectors, oil-cooled pistons—you probably know and like. Others, such as its simplified control and its cross-head-actuated dual valves which prolong engine life and reduce maintenance, are advancements in design that we'd like to show you in detail. Write or wire us for pictures and complete information. No obligation, of course.

JOSHUA HENDY Division

JOSHUA HENDY IRON WORKS

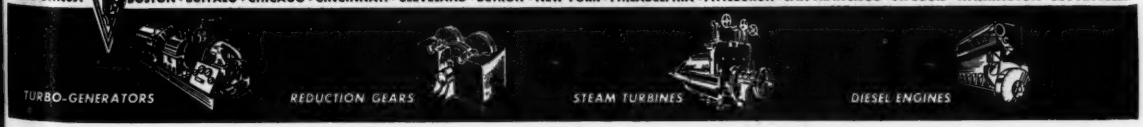
SUNNYVALE, CALIFORNIA

Specifications—6 and 8 cylinders; 4-stroke cycle; 12" bore; 15" stroke; 350-675 hp.

39-V

EST. 1836

Branch Offices: BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DETROIT • NEW YORK • PHILADELPHIA • PITTSBURGH • SAN FRANCISCO • ST. LOUIS • WASHINGTON • LOS ANGELES



Your Blueprint for

MORE POWER

starts with

OAKITE CLEANING

. . . Descaling Jacket Water Coolers Easier

The next time you descale your jacket water coolers, try the easier Oakite way by employing Oakite Compound No. 32. No dismantling is necessary.

Just introduce the recommended solution as directed, let it soak for the prescribed time, then drain, neutralize and rinse. You will be surprised to see how thoroughly insulating lime-scale and rust deposits have been removed.

In comparison with mechanical methods or practices employing raw commercial acids, Oakite descaling is not only safer but also faster. It requires only a fraction of the time formerly required.

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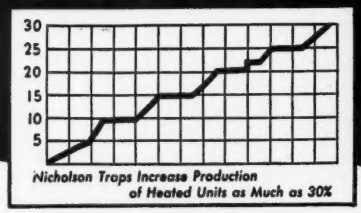
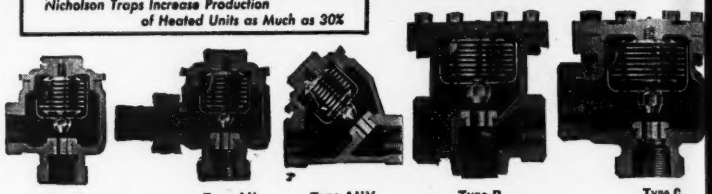
PLANT TESTS SHOW NICHOLSON TRAPS *Raise* PRODUCTION



Nicholson Traps Increase Production of Heated Units as Much as 30%



Type A Type AU Type AHV Type B Type C

Faster Heat Transfer in all Steam Units Assured by QUICK, POSITIVE ACTION

The Nicholson Industrial Steam Trap is sturdily designed for high pressures and severe service, utilizing a heavy-duty bellows with brazed end plates and internal guide rod and tube. Enormous water and air discharging capacity, and positive intermittent valve action —not to be compared with light weight, low pressure radiator traps.

Two to six times greater valve area and capacity than average traps. No Air Binding. No Freeze-Ups. No Adjustment. No Dribbling. No Water-Logged Units. Hardened Stainless Steel Valves and Seats. 5 types—sizes ¼" to 2"—pressures vacuum to 225 lb. Bulletin 843.

W. H. NICHOLSON & CO. **160 OREGON STREET WILKES-BARRE, PA.**

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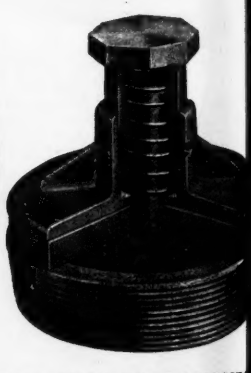

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If your plant operates two or more reciprocating pumps — Boiler Feed, Vacuum, Condenser, General Service—the chances are that you can save up to 15% in steam and cut maintenance cost at the same time by using COMBINATION Pump Valves. They lift straight, close quickly, prevent racing and hammering, eliminate many pump repair bills. Ask for descriptive bulletin.

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Pressurestatic or Thermostatic Contact Makers for lubricating-oil or circulating-water systems for all types of stationary or mobile equipment.

Now available in sheet-steel housing to avoid critical materials.

Can be supplied with complete indicating system.

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Complete alarm system consists of Type M-3B combination pressure control, junction box and visual indicator, together with Type M Thermostatic Contact Maker, and signal howler.

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Where Contact Maker is exposed or must be waterproof, Type C Pressurestatic or Thermostatic is recommended.

Manufacturers of engine alarm systems, annunciators, marine and industrial instruments. Write for specifications.

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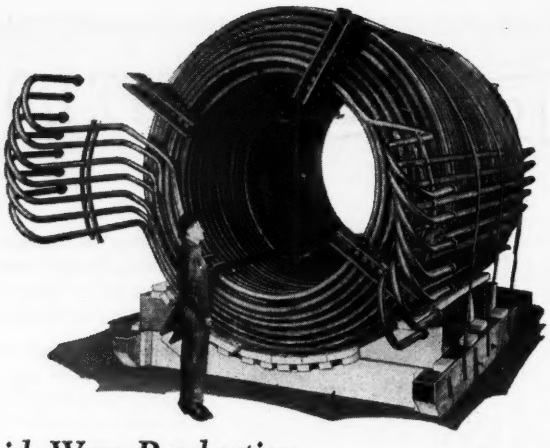

To Aid War Production—

A 1¾ MILE NESTED SPIRAL COIL

Typical of the way in which Rempe engineering and production facilities are contributing to the war effort is this giant multiple spiral coil recently delivered to a machinery fabrication plant.

Built of Grade A-106 seamless steel tubing, with seven separate circuits, this large heating coil contains more than 1¾ miles of pipe and weighs 22,000 lb.

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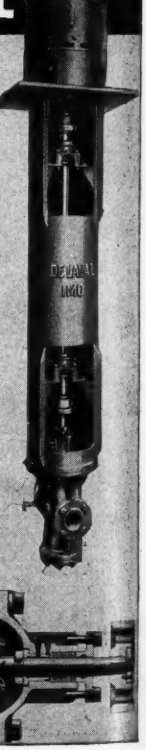
rotary displacement pump, directly connected to a motor running at 1450 r. p. m., delivers oil against a pressure of 330 lbs. per sq. in. to the lubricating system of the vertical thrust bearing of a large hydraulic turbine. The pump end is submerged in the oil sump. There are no valves, no gears and no pump bearings. The flow is without pulsation, as from a steadily advancing piston. Ask for Catalog I-94.



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IMO PUMP DIVISION
of the
De Laval Steam Turbine Co.
Trenton, N. J.

HELPFUL BULLETINS

Answers to many operating and maintenance problems will be found in these new bulletins and catalogs. List paragraph numbers of those you want on coupon below, detach and mail.

BOILER PLANT EQUIPMENT

1 **Forced-Draft Underfeed Stoker**—Brownell Type C underfeed stokers for power, heat, process steam, are described in Bulletin S-70. Three rates of coal feed are provided; drive from motor is by double V belt, with slow speed gears for quietness and long life. The Brownell Co.

2 **Simplified Coal Handling**—Sectional views and installation photos in new folder show how Nicholson storage and handling methods make the coal pile a fluid fuel supply. The Nicholson Co.

3 **Combustion Control**—Bulletin BD44 points out the value of automatic or semi-automatic regulation of furnace draft, fuel feed and steam pressure and offers a complete system for co-ordinating these three phases of boiler operation. The system calls for a sensitive, compensated steam pressure regulator, a responsive control of furnace pressure and a device for assuring correct fuel feed to carry the load. The Engineer Co.

4 **Booklet On 3-Drum Boilers**—Bulletin No. 144 illustrates a number of installations of Bros 3-Drum Type L boilers. The 8-pg booklet shows cross-section views of installations made throughout Illinois, Ohio, Iowa, Wisconsin and Indiana. The type of boiler described is utilized for maximum capacities from 10,000 lbs per hour up to 75,000 lbs per hour and for any desired operating pressure. Wm. Bros Boiler & Manufacturing Co.

5 **Protective Coatings for Boilers**—Pamphlet from Preferred Utilities Manufacturing Corp. discusses advantages of preparations, White Hot and Pyro-Chrome. These coatings take advantage of properties of heat reflectance, a hitherto overlooked principle by which a substantial amount of radiant heat energy is put back to work. Applied like paint to boiler combustion chamber, economizers, breechings, stacks, etc.

ELECTRICAL

6 **Tri-Clad Motors**—Well illustrated and concise in style, publication GEA-3580 gives highlights on the design, construction and application of G-E Tri-Clad electric motors. Includes full details about the extra protection features and other advantages. General Electric Co.

7 **Selenium Rectifier Power Units**—Fansteel Selenium Rectifier Bulletin RDP-105, a new 12-pg booklet contains technical information, specifications, illustrations, wiring diagrams, ordering references on more than 130 standard selenium rectifiers. These include d-c power units for direct operation of chucks, magnetic devices, solenoids, relays, d-c motors, and other direct current appliances; chargers for batteries ranging from 6 to 60 cells, and rectifiers for emergency lighting systems. Fansteel Metallurgical Corp.

8 **New Arc Welding Handbook**—A 48-pg handbook published by The Lincoln Electric Co., describes "Fleet-Welding," a technique of arc welding which increases the speed of the process over conventional welding methods; also cuts costs as much as 59 per cent. Subjects covered include: using "arc force" to increase welding speed; effect of penetration on welding costs; factors affecting production speed and general information for use of procedure tables.

9 **Corrosion-Resistant Motors**—New folder describing mechanical features and application data on the new Crocker-Wheeler Sealedpower motor for chemical and corrosion-resistant service is now available from the manufacturer. Crocker-Wheeler Div., Joshua Hendy Iron Works.

10 **Metal-Enclosed Switchgear**—Safe, steel-clad switchgear, known as Multumite, with air circuit breakers for service up to 600 volts a-c or 250 volts d-c, is described in Catalog 6002, issued by the I-T-E Circuit Breaker Co. Describes construction features such as supporting structure, panels, doors, buses, fittings, and finish. Included are dimensions, conduit locations and approximate weights of both drawout and stationary elements as well as a diagram of standard symbols commonly used in switchgear drawings.

INSTRUMENTS AND CONTROLS

11 **Boiler Meter Publication**—Cochrane Corp. has just issued a publication (No. 4071) on the new Cochrane boiler ratio meter. Introductory pages describe methods of checking combustion efficiency in boiler plants. Then follow the requirements for an ideal boiler meter, and the detailed description of the Cochrane Boiler Ratio Meter which it is claimed completely meet these ideal requirements. Installation details are also given.

12 **3-Point Pipe Gage**—Folder describes operating features of new pocket size three-point pipe gage for instantaneous measurement of all sizes of pipe from ⅛ in. to 12 in. Gage gives drill size for tapping; eliminates guesswork and errors. Three Point Gage Co.

13 **Hydraulic Gauges**—Bulletin describing several types of hydraulic gauges has just been issued by the Watson-Stillman Co. Covers the company's Direct Stem and Flush Mounted Gauges for use on hydraulic presses and pumps where accurate, trouble-free indication of hydraulic pressures is essential. Gives specifications and construction details.

14 **Automatic Controls**—Catalog 600 describes the Mercoid line of automatic controls for regulating electrically operated equipment in accordance with changes in temperature, pressure, vacuum, fluid level or mechanical movement. Mercoid Corp.

MECHANICAL TRANSMISSION

15 **FHP Drive Handbook**—A new 44-pg handbook on industrial fractional horsepower V-belt drives has just been published by The B. F. Goodrich Co. Booklet notes trend toward larger sheaves in both fractional horsepower and multiple V-belt drives. Contains a chapter on proper selection of FHP belt drives, with formulas, together with a page on how to get the most service from V-belt drives. Horsepower ratings and general engineering data of these drives are given.

16 **Motor Pulley Catalog**—New American Hi-Torque motor pulley catalog describes the composition, design, and manufacturing methods that are responsible for high gripping power of Hi-Torque pulleys. It contains dimensions, selection table and list prices. The American Pulley Co.

17 **Fan Cooled Speed Reducers**—Catalog No. 300 issued by The Cleveland Worm & Gear Co. describes Speedaire fan cooled worm gear reduction units. Contains cutaway photographs, charts, diagrams and engineering tables. With Speedaire, heat generated during operation of the unit passes through the oil bath to deeply-finned wall of the reservoir.

18 **Protected V-Belts**—New quick-picture Bulletin B6331 describes five special protected Allis-Chalmers Texrope V-belts. The Heat-Resisting Super-7 is a standard Texrope belt made of Buna-S which can operate easily at 180 deg F ambient temperatures. Oil-Resisting Super-7 is a regular Texrope Buna-S belt core protected by a Neoprene rubber synthetic covering. The Oil-Proof Super-7 belt is made of solid Neoprene, designed to withstand heavy-duty oil conditions.

PIPING, VALVES AND FITTINGS

19 **Condenser Tube Handbook**—Chapter headings in new 60-pg Scovill Condenser Tubes handbook include: Tube corrosion; Selection of tube material; Composition and physical properties of tube alloys and common metals; Installation methods; Specification; Data tables. A helpful reference for engineers with condenser and heat exchanger problems. Scovill Manufacturing Co.

20 **Valves and Fittings**—Comprehensive Catalog No. 43 describes, gives dimensions and lists prices of Jarecki valves and fittings. Flexible binder, 110 pg. Jarecki Manufacturing Co.

21 **Asbestos-Cement Pipe Handbook**—"Mains without Maintenance" is title of 36-pg handbook describing strong, non-corrosive Century asbestos-cement pipe. Includes adaptations, service connections, carrying capacity and pumping costs, specifications and other data useful to design and maintenance engineers. Keasbey & Mattison Co.

22 **Valve Selection Guide**—Catalog describes bronze, iron and steel valves, boiler mountings; fittings, gages, flanges; lubricating devices, whistles; includes steam tables for saturated and superheated steam. Write for Catalog 78 and the Guide for Selecting Valves. The Lunkenheimer Co.

Coupon must be filled in completely to secure literature you request. Pasting coupon on penny postcard saves time and money.

SEPTEMBER, 1944

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70

OVER 50 YEARS
OF AUTOMATIC TEMPERATURE AND HUMIDITY CONTROL

23 New Diaphragm Valve—Those interested in a practical valve for hard-to-handle liquids will want a bulletin describing the new McAlear Diaphragm valve. Service advantages include: positive shut-off, no reseating, leakproof in any position, low maintenance. Bulletin contains service data, specifications, special applications. McAlear Manufacturing Co.

24 Bursting Pressure of Seamless Tubing—Booklet "Bursting Pressure of Seamless Steel Tubing" gives helpful data for engineers and those who deal with boiler, still, condenser heat exchanger and other pressure tubing. Contains calculation on tubes in sizes from ⅛ in. to 9⅜ in. outside dia. Globe Steel Tubes Co.

25 Safety and Relief Valves—New 168-pg catalog contains dimensions, construction details, service recommendations, sizing charts, etc., on Consolidated safety and relief valves. Also has engineering data helpful to valve users. Consolidated Safety Valve Div., Manning, Maxwell & Moore, Inc.

MISCELLANEOUS

26 Open Steel Grating—A book of information on open steel grating has just been issued by Wm. F. Klemp Co. Illustrated with photographs of the products in actual plant uses, it adds to construction particulars, drawings and tabular specifications. Includes uses of riveted and welded types of grating for open steel flooring, stairways, fire escapes, loading platforms, catwalks, tower-stairs, boiler and engine rooms, etc.

27 Welding Anti-spatter Fluid—A new engineering bulletin, describing tests made to determine effects of using an anti-spatter fluid in welding, has just been issued by The Midland Paint and Varnish Co. Contains a concise report of a process used by a large metal fabricator to reduce mill scale formed during normalizing. It suggests a method of keeping welding jigs free from spatter.

28 Liquid Dispensing Equipment—New 12-pg bulletin describes Bowser storage and dispensing equipment for handling oils, paint, gasoline, naphtha, etc. Gives pump and tank specifications; suggestions for handling liquids with greater accuracy and safety. Bowser, Inc.

29 Preventing Water Tank Corrosion New folder tells how the Rustop system prevents rust and corrosion in water tanks. Works electrically; installed without draining the tank; removes old rust. Electro Rust-Proofing Corp.

30 Pneumatic Materials Handling—A-S-F Bulletin No. 744 shows construction details and installation hookups of Hydrovactor unit for transporting pneumatically many materials used in industry. This unit operates with multi-jet hydraulic air pump., requires little maintenance. The Allen-Sherman-Hoff Co.

31 Boiler Stud Welder—Catalog describes the Nelson stud welder for repairing burned-out boiler tubes. Unit is portable and light in weight; one operator and helper can average about 2300 studs or about 24 ft of tube in 8 hr. Can be used wherever there is need to end-weld studs to metal. Nelson Specialty Welding Equipment Corp.

32 Wire Rope Conservation—Recent bulletin contains useful information such as: How you can lengthen wire rope life by proper sheave maintenance—Correct rope reeving—Methods of lubricating—Protection against corrosion. Macwhite Co.

33 Silencer and Spark Arrester—Attractive 4-pg folder gives construction details, dimensions, advantages of Sims-Whittington silencer and spark arrester for internal combustion engines. Silences and cleans gases from engine outlets 1 in. through 18 in. The Sims Co.

SERVIRON Protects Boiler and Tank Interiors Against RUST and FUNGI

Odorless Tasteless

Serviron is an odorless, tasteless, permanently viscous material. It protects metal against corrosion, and prevents deterioration and fungus growths on wood, concrete or metal, submerged in water, brines and certain acids and caustics. Serviron is used extensively in boilers, laundries and refrigeration plants. It is unaffected by feed water treatment, and is used with equal success in hard and soft water. Serviron is ideal for drinking water tanks.

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Serviron may be applied to any clean, dry surface with a stiff brush, and spread until a very thin coat remains. The applicator can work comfortably in cramped quarters because no obnoxious odors or gases are emitted.

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Serviron may be used in hot or cold water tanks, indoors or outdoors. Since it remains viscous within a wide temperature range, it expands and contracts with the surface, eliminating the danger of hairline cracks.

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it's simple to apply!

Here's an insulation that can take hard knocks without denting or shattering—can withstand severe vibration without either sagging or gapping. Unibestos' resilient, tough fibrous construction affords outstanding structural strength.

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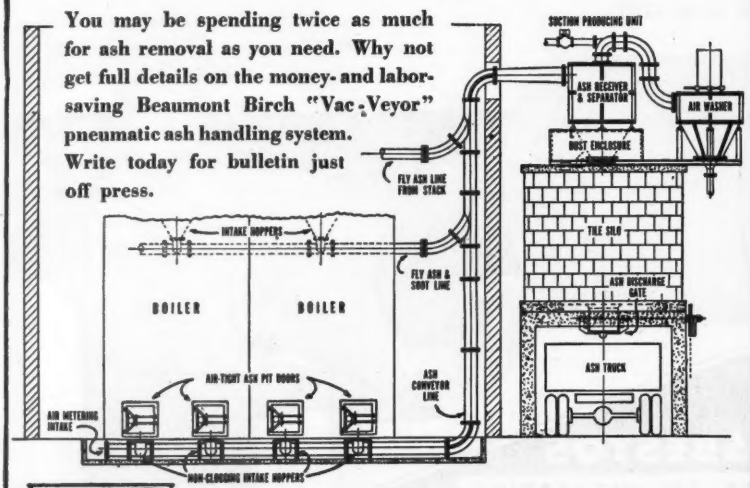

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POSITION WANTED—In Industrial Power and Refrigeration:—7½ yr District Refrigeration and Maintenance Engineer for large meat packing company; past 3 yr executive installing refrigeration and air conditioning on submarines and cruisers, with running tests and dock trials. Grade A license for many years. Address Box 1451, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Ill.

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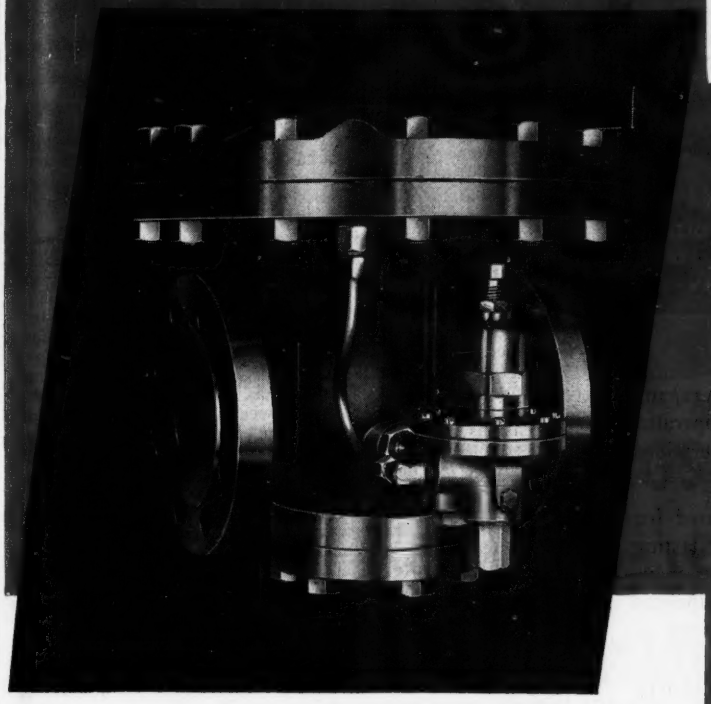
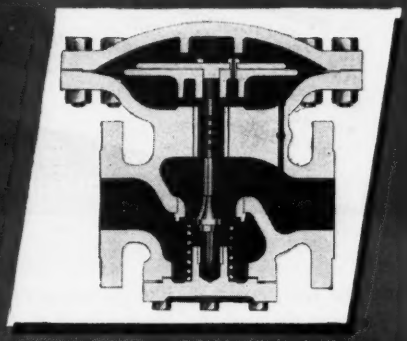
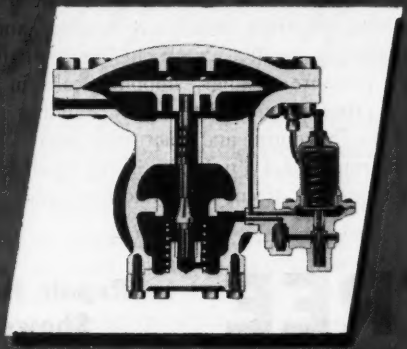
SPECIALLY DESIGNED FOR STEAM PRESSURE CONTROL

FISHER TYPE 92

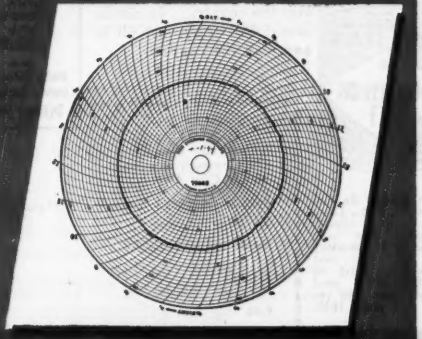




Sectional view showing inlet and outlet passages.



Sectional view showing cross section of pilot assembly.



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ACCURATE . . . pilot control is extremely sensitive to flow changes — accurately maintains desired reduced pressure. *FLEXIBLE* . . . two pilot assemblies for high or low pressure service, easily adjusted to your requirements. *STURDY* . . . high-tensile bodies and diaphragm casing of rugged ribbed construction — inner parts Duromite bronze or stainless steel as ordered. *COMPACT* . . . but has unusually large capacity. No special wrenches needed for servicing. Ten sizes, ½" to 2" screwed or 1" to 6" flanged.

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CRACKED BALL MILL

The ends of the crack were drilled and plugged and its edges beveled slightly with a sharp scraper. Smooth-On No. 1 was then applied under a reinforcing patch-plate and into the crack. The mill was again ready for use as soon as the Smooth-On hardened.

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Power Plant Construction News

CALIF., GARDENA—Dow Chemical Co., 20,021 South Vermont Ave., plans expansion in local styrene plant for production of materials for synthetic rubber and other manufacture. Several new units will be built. Electric power equipment will be installed. Proposed to begin work early in fall. Entire project will cost close to $1,700,000. Stone & Webster Engineering Co., with local office at plant site and main offices at 49 Federal St., Boston Mass., is consulting engineer.

CALIF., STOCKTON—Bureau of Yards and Docks, Navy Department, Washington. D. C., plans large boiler plant at new naval supply depot near Stockton, for which tract of 1400 acres of land has been acquired. A power substation will be built, with electrical distribution system. Entire development is estimated to cost $9,825,000. Public Works Office, 12th Naval District, Federal Office Bldg., San Francisco, Calif., is in charge.

CONN., STRATFORD—Raybestos-Manhattan, Inc., 75 East Main St., manufacturer of brake lining and other asbestos products, plans installation of electric power equipment in new one-story addition, 70 x 120 ft. for which superstructure will begin soon. Project has a priority rating. Cost reported close to $50,000.

GA., SAVANNAH—Union Bag & Paper Corp., manufacturer of kraft paper stocks, has surveys and plans under way for new steam-electric power plant at mill, including extensions and improvements in electric power system for mill service. Entire program is reported to cost over $1,200,000. Rust Engineering Co., Clark Bldg., Pittsburgh, Pa., is engineer and will supervise installation.

ILL., SPRINGFIELD—Water, Light & Power Department has plans under way for addition to Lake Side municipal steam-electric generating station, with installation of new high-pressure boilers, 25,000-kw turbine-generator unit and auxiliary equipment. Project will be carried out as a postwar development, and is reported to cost over $1,600,000. Burns & McDonnell Engineering Co., 107 West Linwood Blvd., Kansas City, Mo., is consulting engineer.

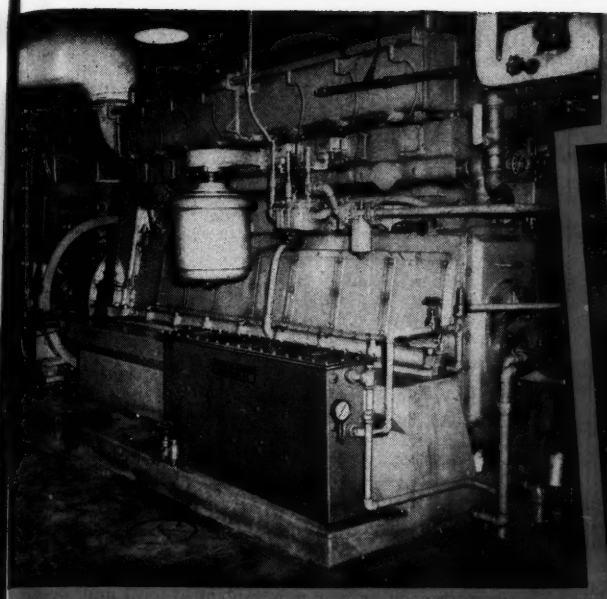
KAN., TOPEKA—Goodyear Tire & Rubber Co., Inc., 1144 East Market St., Akron, Ohio, plans installation of electric power equipment in new mill at Topeka. one-story, 150 x 900 ft, for production of tires for Government. A power plant will be built. Entire project is reported to cost over $3,500,000. Work is scheduled to begin soon. J. Gordon Turnbull, Inc., Fidelity Bldg., Kansas City, Mo., and 2630 Chester Ave., Cleveland, Ohio, is consulting engineer.

LA., SHREVEPORT—Brewster Co., 50 Fannin St., manufacturer of oil well supplies, plans boiler house at proposed new plant in Augurs district of city. where tract of 8 acres of land has been acquired. Main factory unit will be 140 x 320 ft. with several smaller structures. Electric power equipment will be installed. Entire project will cost close to $700.000. A priority rating has been secured. E. M. Freeman, City Bank Bldg., Shreveport, is engineer.

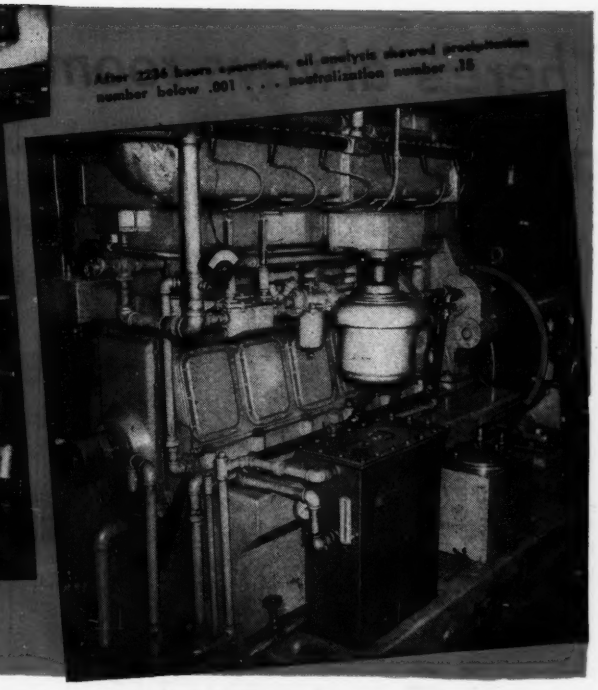
MD., BALTIMORE—National Gypsum Co., 325 Delaware Ave., Buffalo, N. Y., manufacturer of plaster, wall board, insulating board, etc., has acquired tract of about 14 acres of land in Canton district, Baltimore, for new branch mill, to be carried out as post war development. It will comprise a group of one-story buildings, equipped for large output. Electric power equipment will be installed. A boiler house is planned. Entire project is reported to cost over $3,500,000.

MASS., SPRINGFIELD — Monsanto Chemical Co., Plastics Division, 600 Monsanto Ave., plans installation of electric power equipment in new three-story plant addition, about 60 x 103 ft, reported to cost over $100,000. A priority rating has been secured and work on superstructure will begin soon.

N. Y., JAMESTOWN—Municipal Light Department, City Hall, plans post war expansion and improvement program in municipal steam-electric generating plant and electrical distribution system. Fund of about $2,000,000 has been authorized for project. An engineer will be selected to make surveys and plans at early date. Board of Public Utilities, A. C. Davis, chairman, is in charge.



After 1492 hours operation, oil analysis showed precipitation number below .001 . . . neutralization number .25



After 2236 hours operation, oil analysis showed precipitation number below .001 . . . neutralization number .15

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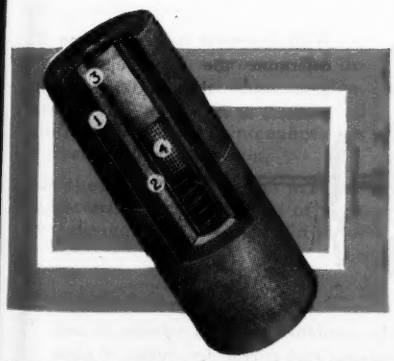

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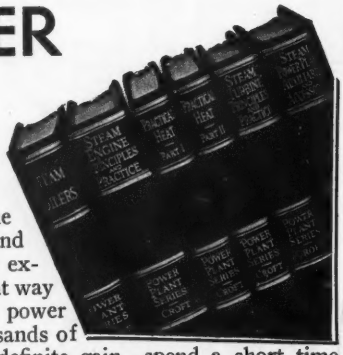

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Position PPE-9-44

OHIO, AMHERST—Municipal Light Department has plans maturing for new municipal electric power plant, for which financing is being arranged through Federal aid. No official estimate of cost announced. A priority rating has been secured and work is scheduled to begin in near future.

OKLA., ARDMORE—Choctaw Cotton Oil Co., Ada, Okla., plans installation of electric power equipment in connection with proposed rebuilding of cottonseed oil mill at Ardmore, recently destroyed by fire, with loss reported close to $100,000. Application has been made for a priority rating.

TEXAS, HOUSTON—Houston Oil Field Material Co., Inc., 1524 Maury St., manufacturer of oil well drilling and fishing tools, has plans maturing for new plant on Wayside Dr., where tract of about 14 acres of land has been selected. It will comprise a group of 8 main buildings. Electric power equipment will be installed. A boiler house will be built. Entire project will cost approximately $1,000,000, and will have a priority rating. Harvin C. Moore, 2008 West Alabama St., Houston, is architect.

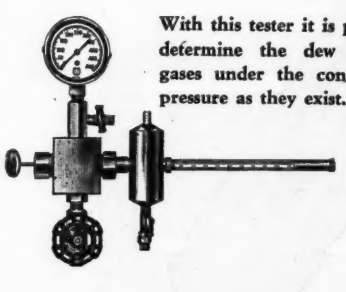
VA., ALTAVISTA—Pacific Mills, Inc., Lawrence, Mass., manufacturer of worsted goods, rayons, etc., has acquired tract of about 600 acres of land near Altavista, and will use as site for new branch mill, to be carried out as a post war project. It will comprise several large one-story units. Electric power equipment will be installed. A boiler house is planned. Entire project is reported to cost over $500,000.

WIS., EAU CLAIRE—United States Rubber Co., will begin work soon on new power plant at local mill, operated under lease for Government, which will provide financing for station. No official estimate of cost announced. J. Gordon Turnbull, Inc., 2630 Chester Ave., Cleveland, Ohio, is consulting engineer.

WIS., SHEBOYGAN—Kingsbury Breweries Co., 1012 New York Ave., plans installation of electric power equipment in new mechanical-bottling plant, one and two-story, 55 x 145 ft, at Wisconsin and North 10th Sts., estimated to cost over $80,000, with machinery. Application has been made for a priority rating. Satre & Senescall, 802 Michigan Ave., Sheboygan, are architects.

— Accurate Determination —

Dew Point Tester



With this tester it is possible to determine the dew point of gases under the conditions of pressure as they exist.

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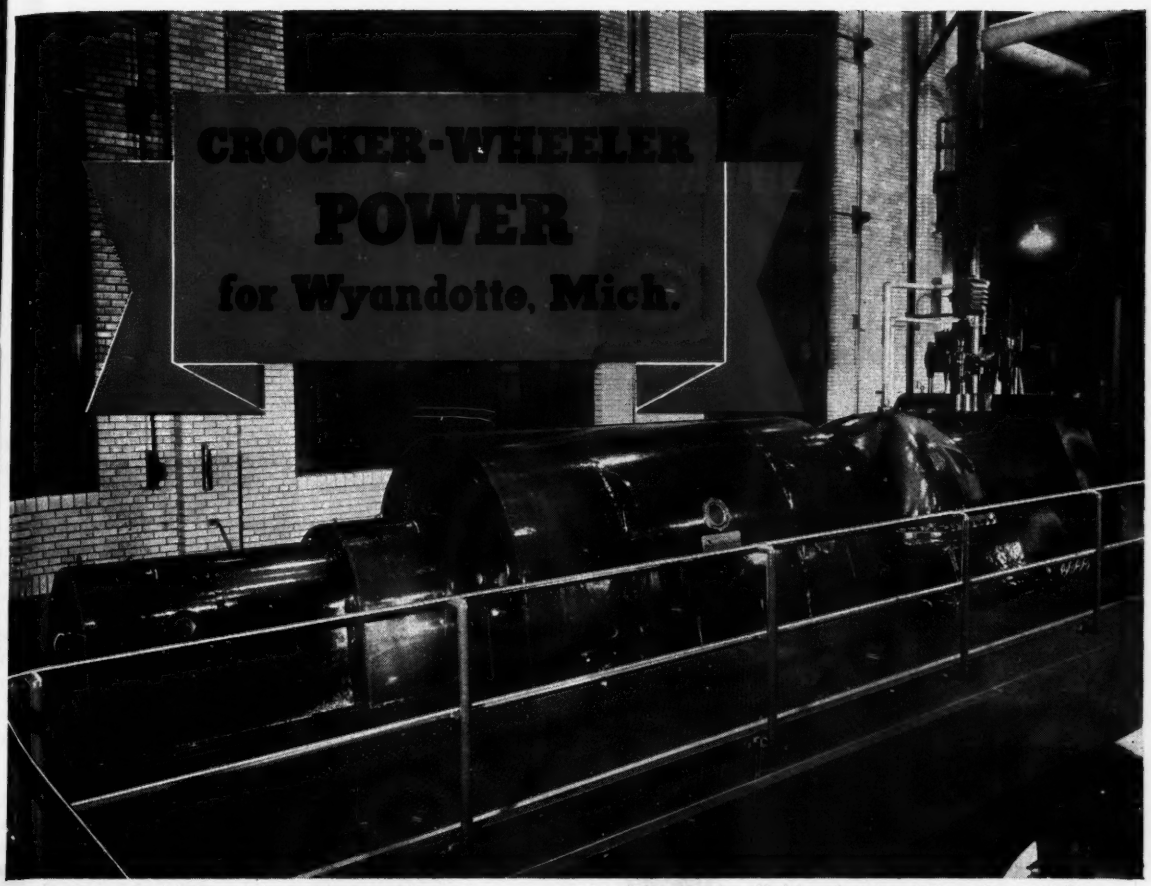

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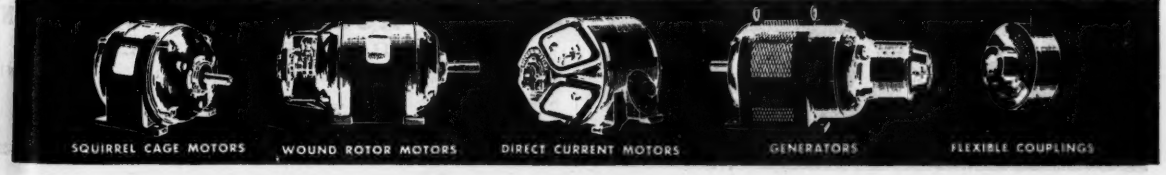

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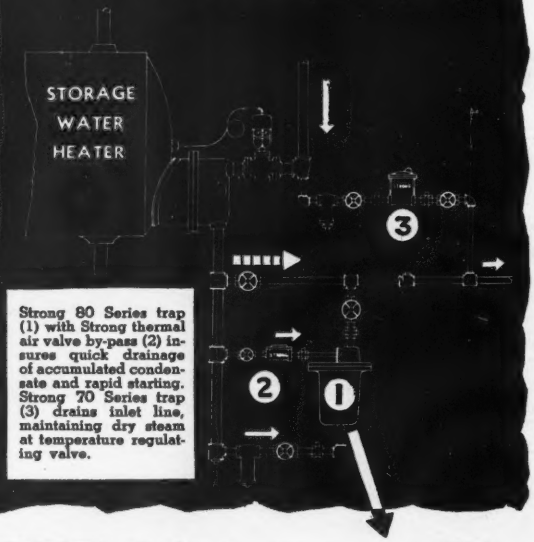

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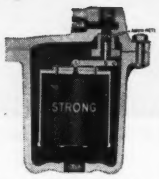
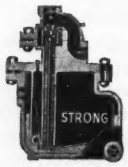


Strong 80 Series Trap for medium or high pressures



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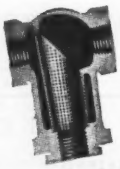

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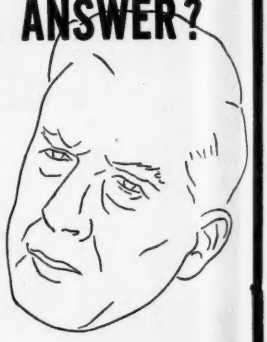
WHAT'S THE ANSWER?



Never before have so many questions faced the American people as they do today. No wonder that perplexity is the common expression to be found wherever you go.

War . . . its very nature being that of destruction . . . disrupts the normal, sane way of living. Happily, recent events are causing the pendulum to take a gigantic swing toward the cause of the Allies, registering a tremendous increase since Pearl Harbor.

This very fact brings up many questions. Business men, especially those executives, engineers and maintenance men engaged in Manufacturing, Transportation, Contracting and kindred Industries, want to know about their source of supply in the post-war period.

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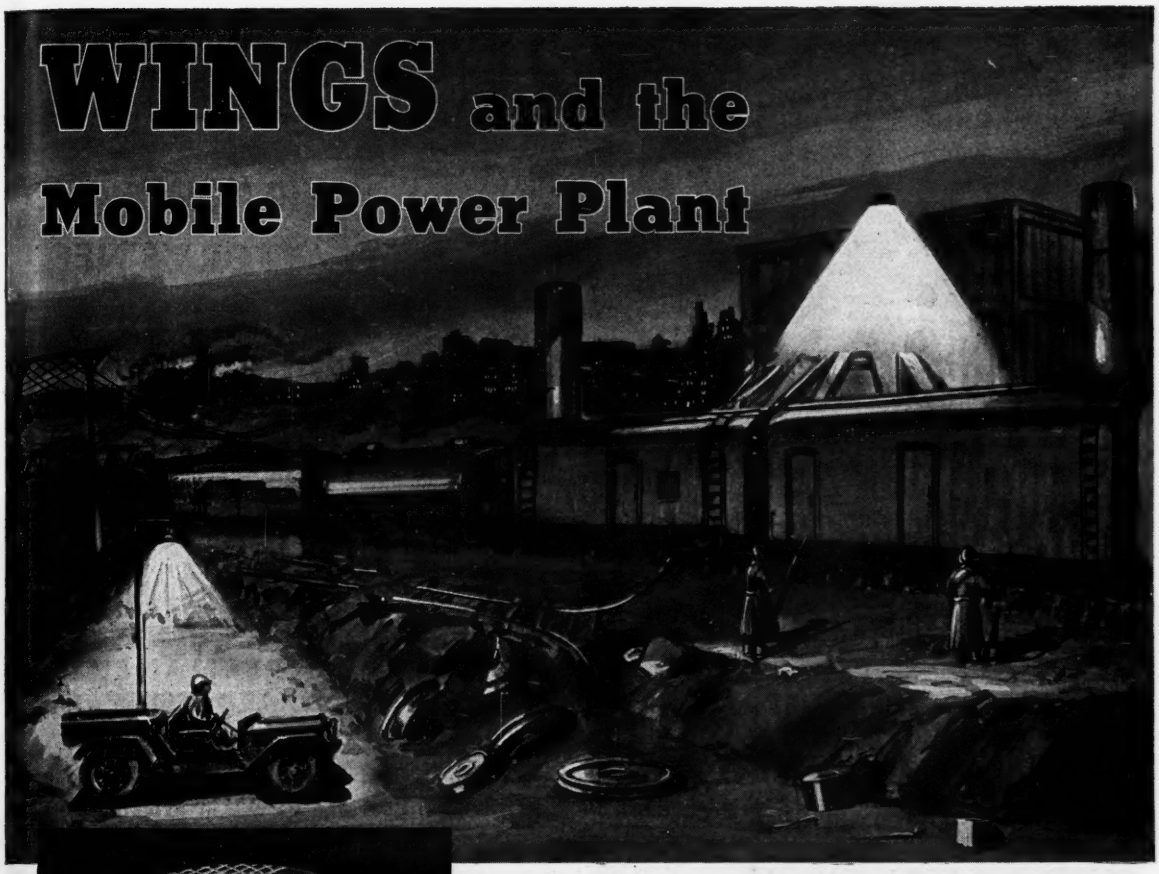
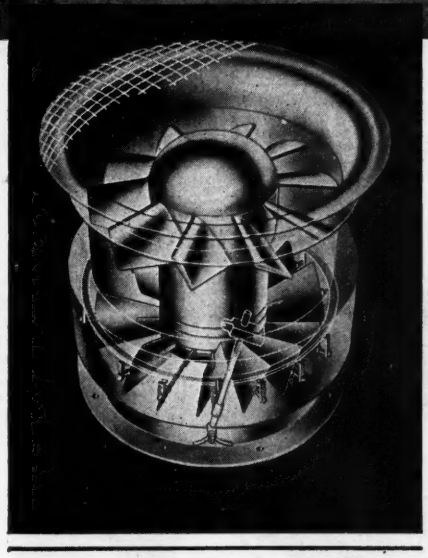
WINGS and the Mobile Power Plant





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When the Russian army started moving the German armies out of the lands they had over-run in 1941 and '42, they found ruin and desolation wherever the bloody boot of the Nazi had trod. With the determination of a victorious people, they started to re-build. Now as the sweep of victory moves on, they are finding new ways of hastening the rehabilitation of their ruined cities and towns.

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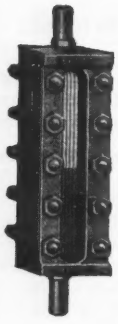

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Fig. 37 ← → Fig. 45

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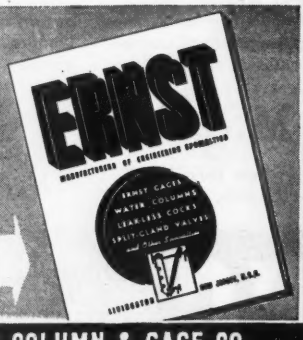

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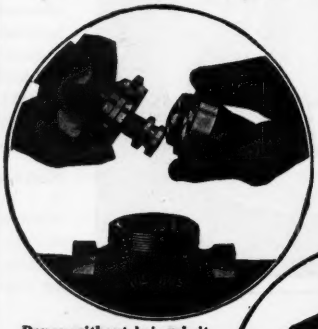

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- HB (hardened bearing) type chain
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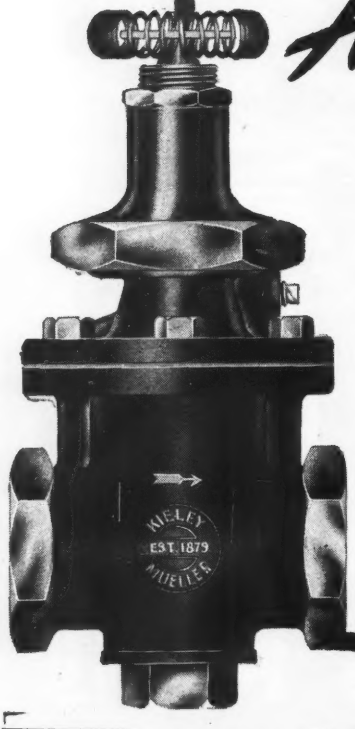
Union Catalog A-2 covers Drive and Conveying Chains. Catalog B-2 covers Finished Steel Roller Chain and Sprockets. Ask for your copies.

UNION CHAINS



Accurate AS A GARAND
and just as compact!

A fraction turn of the handwheel—and you can control *exactly* the pressure of steam passing through this very compact K & M Reducing Valve. Model 481 is widely used for difficult reduction service in industrial processes—and as a primary valve in double reduction installations. Self-contained . . . made in bronze . . . available in valve sizes of ½" to 2"—with 5⅜" the maximum overall measurement, face to face! Yet it accurately controls inlet pressures up to 250 lbs. . . . maintaining constant reduced pressures of 2 lbs. to 80% of the inlet. If you have a tough pressure reduction problem, perhaps K & M #481 is the answer. Our Engineering Department invites your inquiries.

Write for General Catalog 66

KIELEY & MUELLER, INC.
MANUFACTURERS OF PRESSURE AND LEVEL CONTROLS
NORTH BERGEN, NEW JERSEY

Awarded our employees for outstanding production achievement.

THE FOUR FREEDOMS

1 FREEDOM *from* DUST *and* DIRT

2 FREEDOM *from* CORROSION

3 FREEDOM *from* OPEN ARCING

4 FREEDOM *from* PITTING *or* STICKING CONTACTS

MERCURY SWITCHES ★ BY MERCOID ★

Mercoid hermetically sealed mercury switches are the most dependable means for opening and closing an electrical circuit. They are designed to give millions of "makes" and "breaks" in the electrical circuit. ★ These switches are used on many industrial applications. ★ Various types available. ★ Our engineers will assist in their application to any of your switch problems.

THE MERCOID CORPORATION, 4229 W. BELMONT AVE., CHICAGO 41, ILL.

SAVE COAL
WITH FYR-FEEDER MULTIPLE SPREADER STOKERS!

Write today. Ask for new Catalog describing FYR-FEEDER design and features.

FYR-FEEDER stoker firing not only saves coal, but also permits you to burn any kind of bituminous coal available—screenings or sweepings, any melting point of ash, free-burning or coking coals. WET COAL is no handicap . . . Fyr-Feeders are designed to handle WET or dry coal.

FYR-FEEDER burns fines in suspension, burns larger pieces on grate. Coal is spread over entire fuel bed. Thin fuel bed—no clinkers. Fires can be cleaned in two minutes! Suitable for large or small boilers. Very little maintenance cost. In many cases FYR-FEEDER stokers have made it unnecessary to add another boiler to handle loads. WRITE FOR CATALOG.

AMERICAN COAL BURNER CO.
ENGINEERS, EST. 1918
22-18 East Erie Street Chicago 11, Illinois

Atop the METHODIST HOSPITAL, the Health Beacon stands in majestic proportion in the skyline to remind every passerby that the Hospital is a haven of safety.

Like Another Endowment TO THIS GREAT HOSPITAL

SKINNER "UNIVERSAL UNAFLOW" STEAM ENGINES

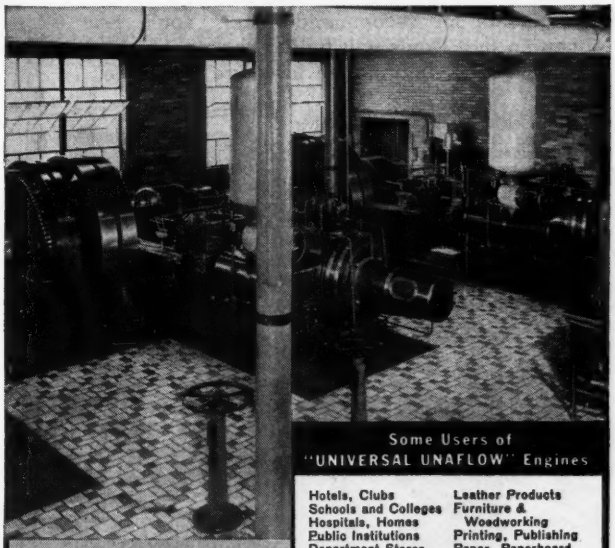
The METHODIST HOSPITAL stands in Indianapolis, a notable monument to the Hoosier citizens' spirit of devotion to science, philanthropy and religion. One of the largest and most complete institutions in the country, it serves as a model for other progressive communities to emulate. It has service facilities that rival those of the finest hotels—stores, restaurants, guest rooms, laundry, and the last word in scientific equipment in laboratories, operating rooms, and at the bedside of the patient.

It was only natural that those responsible for planning this great medical center should insist that it be as self-sufficient as possible, and to that end, that electric power be generated within the institution. Skinner "Universal Unaflow" Steam Engines were chosen because of their proven dependability and economy in hundreds of similar installations.

For the figures prove that an annual return of 150% on their actual investment is not unusual to many owners of Skinner Engine Power Plants—the savings being based on the cost of power generated by Skinner "Universal Unaflow" Engines in comparison with the cost of purchased power. Where can another endowment investment be found which will yield such returns?

At the METHODIST HOSPITAL, all energy for power and lights is generated by two Skinner "Universal Unaflow" Engine-Generator Units of 300-kw. and 200-kw. capacity respectively. A third unit of 300-kw. capacity is held in reserve. Exhaust steam from the engines is used for hot water and building heating purposes.

Such institutions as hospitals, hotels, laundries and office buildings, where there are requirements for considerable quantities of low-pressure steam, are everywhere finding in Skinner installations the answer to their search for economical power.



Part of METHODIST HOSPITAL engine room showing 300-kw. and 200-kw. "Universal Unaflow" engine-generator units.

Some Users of "UNIVERSAL UNAFLOW" Engines

Hotels, Clubs	Leather Products
Schools and Colleges	Furniture & Woodworking
Hospitals, Homes	Printing, Publishing
Public Institutions	Paper, Paperboard
Department Stores	Laundries, Cleaners
Office Buildings	Oil Refineries
Railroads	Stone and Brick
Meat Packing	Gas Plants
Dairies	Municipal Water & Electric Plants
Breweries	Cotton Oil Mills, Gins
Food Products	Rubber
Ice & Cold Storage	Glass
Mining	Bakeries
Chemical, Ordnance	Tobacco
Drugs and Soaps	
Machinery Mfrs.	
Textiles	

BUY *EXTRA* WAR BONDS

For Over 75 Years, Doing One Thing Well—Building Steam Engines

SKINNER ENGINE COMPANY, ERIE, PA.

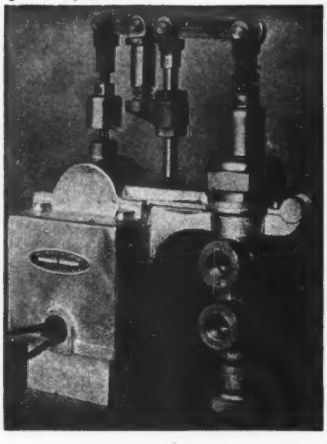
make it Automatic

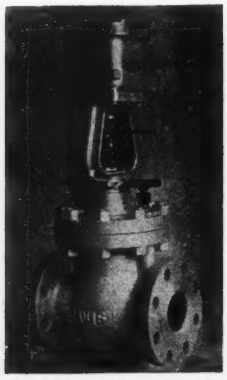
with Davis Industrial Type Solenoid Valves

Freedom from manual control and from fear of disastrous failures is yours when you specify Davis Solenoid Valves. These valves are available for steam, gases and liquids in sizes from 1½" to 12" and pressure to 1500 lbs. Any device capable of making or breaking an electrical circuit will operate Davis valves. Available with either normally closed or open valves, explosion proof solenoid boxes and two step action when extreme accuracy is required.

Wherever an automatic valve will improve your piping system, be sure to write Davis engineers for recommendations. You'll be certain that Davis will furnish the right valve for the job. Informative literature available.

Below—No. 380—a 3 or 4-way pilot valve widely used on air or liquid actuated power cylinders.





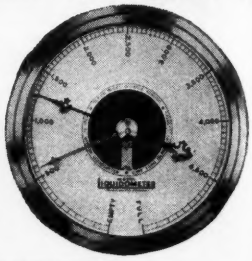
Above—No. 93-H with solenoid operated pilot valve and hydraulically actuated main valve built for use on a 400 lb. pressure water main.

DAVIS REGULATOR COMPANY

2508 S. Washtenaw Ave. Chicago, Ill.

DAVIS REGULATOR CO.

ACCURATE LIQUID LEVEL INFORMATION AT A GLANCE, WHEN YOU WANT IT—



WITH

LIQUIDOMETER *Tank Gauges*

"THEY'RE ALWAYS DEPENDABLE"

100% automatic.

No pumps, valves, or auxiliary units needed to read them.

Models available for either remote or direct readings.

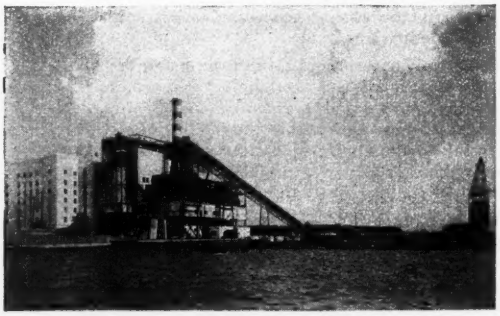
Accuracy unaffected by specific gravity of tank liquid.

Approved by Underwriters' Laboratories for gauging hazardous liquids.

Write for complete details.

THE LIQUIDOMETER CORP.

36-31 SKILLMAN AVE., LONG ISLAND CITY, N.Y.



One of America's Latest Stations

Coal Preparation by "Pennsylvania" Bradford-Hammermill

"Pennsylvania" STEELBUILT Coal Preparation Machinery, developed during the past 40 years, in six types and over 150 sizes, has been specialized for the requirements of Central Stations, Industrial Power Plants, By-Product Coke Plants, Mines and Coal Cleaning Plants.

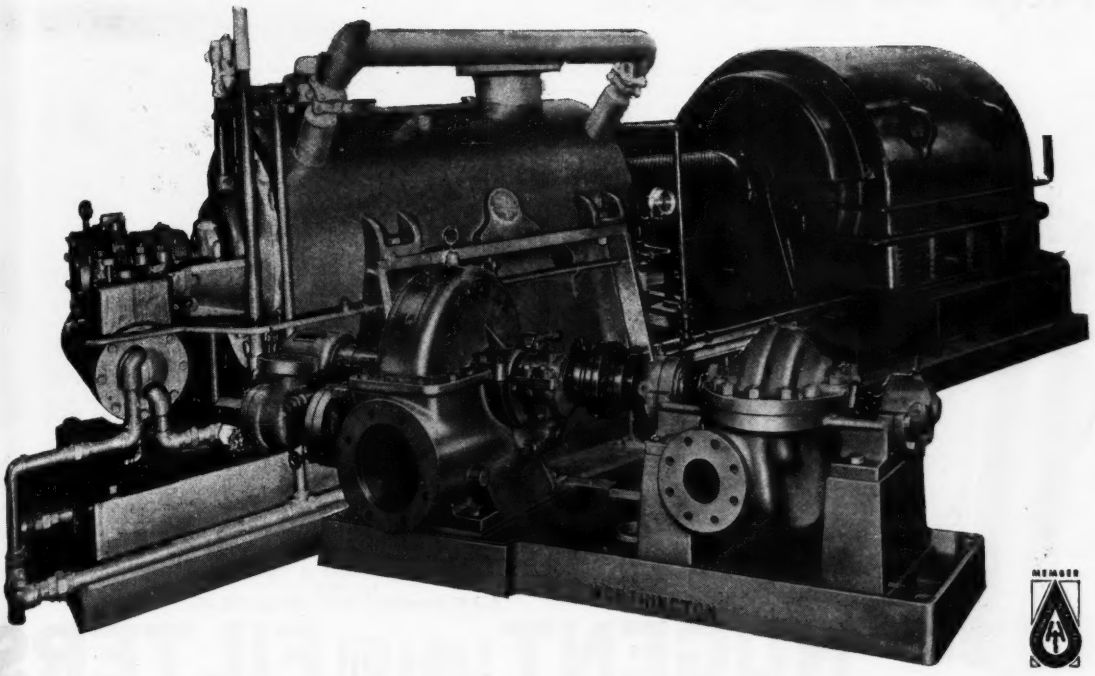
Experience with a rapidly increasing number of installations, with capacities now totaling well over 200,000,000 tons per annum, is the basis for our recommendations o efficient Coal Preparation Equipment, specialized for yo requirements.

Our Engineers are at your service

PENNSYLVANIA CRUSHER COMPANY

1706 Liberty Trust Bldg., Philadelphia 7, Pennsylvania
New York, Pittsburgh, Chicago, Los Angeles, Birmingham
Associated with Fraser & Chalmers Engineering Works, London

WHAT MR. LITTLE LEARNED FROM MR. BIG



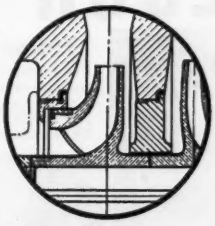
Explains Why Worthington Low Pressure Boiler Feed Pumps Give You More Value For Your Money

"Mr. Little"—the low pressure boiler feed pump—learned a lot at Worthington from high-pressure "Mr. Big".

The same pump engineering ability that built the first high pressure boiler feed pumps in the U. S. (above 1200 p.s.i.) . . . and made them able to operate 30,000 hours—and more!—without major or minor overhaul . . . built the low pressure centrifugal pump (type UB2—150 to 500 p.s.i.) illustrated above.

Investigate, in Bulletin W-318-B11B, its many advantages. Find out how *balanced design* eliminates end thrust . . . how *"elastic seal"* rings prevent interstage leakage . . . how its *rigid center support* prevents misalignment from expansion. Write us, or telephone our nearest district office. *Worthington Pump and Machinery Corporation, Centrifugal Pump Division, Harrison, N. J.*

WORTHINGTON'S "ELASTIC SEAL" RINGS PREVENT PUMP TROUBLES BEFORE THEY START



Interstage leakage (a common cause of pump breakdowns) is definitely ended with Worthington's exclusive "Elastic Seal" Rings on the job.

Other low-maintenance construction features: accessible, horizontally-split casing . . . both stuffing boxes under minimum pressure...simple rotor construction...no diffusion vanes.

WORTHINGTON BEHIND THE NAME WORTHINGTON

CP4-19

WORLD'S LARGEST MANUFACTURER OF PUMPS

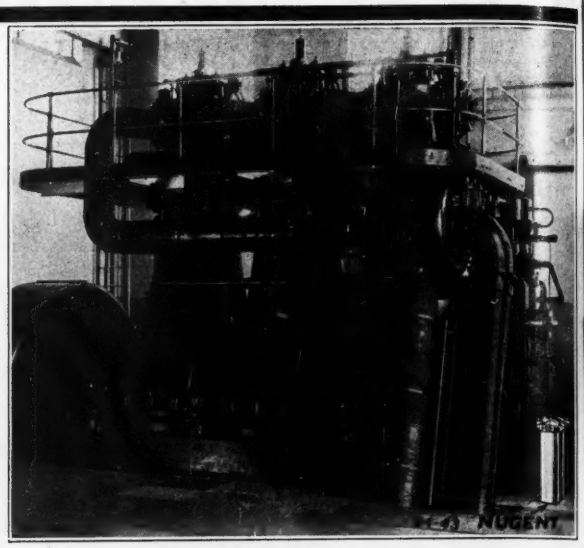
STEAM POWER ROTARY TURBINE WELL CENTRIFUGAL

HOW TO
"Keep Oil in Service"

Today it's sound economy *plus* a patriotic duty to keep the lubricating oil in your Diesels *dirt-free!* By keeping oil clean you help to *Keep Oil in Service* and at the same time add hours of life to your Diesel engine, reduce maintenance costs and increase engine efficiency. You can depend on Nugent Lubricating Oil Filters for this vital service.

The Absorbent Filter Recharge used in this Nugent Absorbent Depth Type Pressure Filter absorbs four times its own weight of water, dirt and impurities, yet it does not remove additives embodied in the oils. Fig. 1280A #41

NUGENT TRADE MARK



The photo above shows two Nugent Absorbent Type Lubricating Oil Filters installed on a Fulton Diesel engine at a pipe line station. About a year ago a supercharger was installed on this engine, increasing the HP from 520 to 890. The Nugent Filters were installed at that time. The engine was charged with three barrels of medium lubricating oil which has been in service since the supercharger was installed. Approximately one gallon of crank case oil is added every 24 hours. Recent tests show only 0.010% very fine sediment in the oil . . . proof of the efficiency of Nugent Filters. Write today for latest bulletins.

WM. M. NUGENT & CO., Inc.
Est. 1897
423 N. Hermitage Ave. Chicago 22, Ill.

NUGENT Lube Oil FILTERS

HEAVY DUTY FLOOR PATCH

Takes Traffic Immediately

Use durable INSTANT-USE . . . a tough, plastic material which you simply shovel into hole —tamp—and run traffic over immediately. NO WAITING. Bonds tight to old concrete. Makes smooth, solid, heavy-duty patch. Withstands extreme loads. Keep a drum on hand for emergencies. Immediate shipment.

A FLEXROCK PRODUCT

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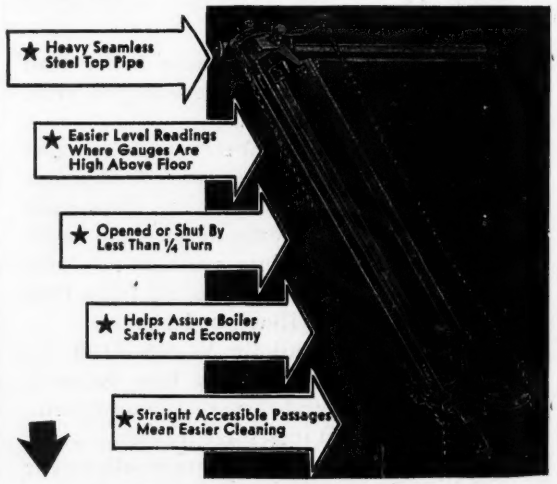
INSTANT-USE

FLEXROCK COMPANY
3623 Filbert St., Philadelphia 4, Pa.

Please send me complete INSTANT-USE information and details of FREE TRIAL OFFER—no obligation.
Name .....
Company .....
Address .....

Get these Advantages with "P B H" TILTVIEW GAUGES


★ Heavy Seamless Steel Top Pipe
★ Easier Level Readings Where Gauges Are High Above Floor
★ Opened or Shut By Less Than ¼ Turn
★ Helps Assure Boiler Safety and Economy
★ Straight Accessible Passages Mean Easier Cleaning

Now with increased boiler safety and economy a wartime rule, "PBH" Tiltview Water Gauges for high-up locations are a timely investment. Tiltviews offset right or left. Write today for latest catalog and prices.

Huyette Products Include
GAUGE COCKS
GAUGE GLASS PROTECTORS
AIRTITE BOILER WALL COATING
WATER COLUMNS
BOILER ALARMS

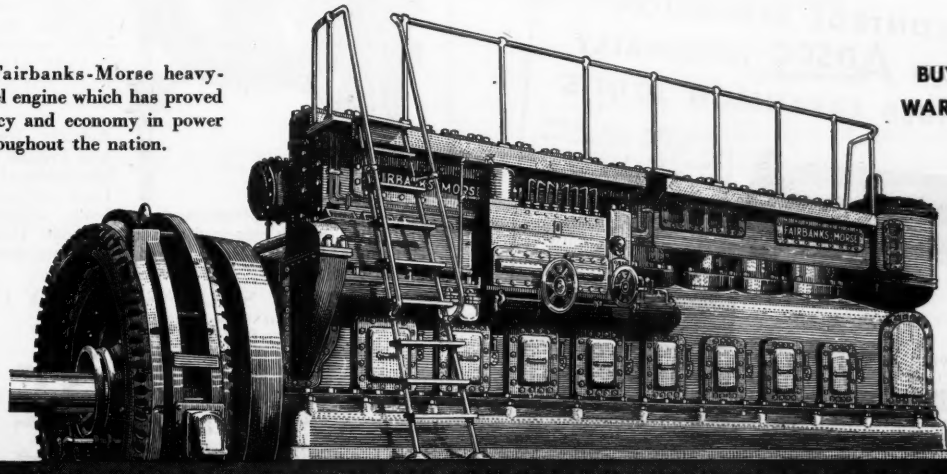
THE PAUL B. HUYETTE CO., INC.
401 N. Broad St. • • Philadelphia, Pa.

A name worth remembering!

FAIRBANKS-MORSE

After the war, the name Fairbanks-Morse will continue to mark performance-proved products only, as it has for 114 years. No race to get civilian products onto the market early will tempt us to break this pledge.

Below — Fairbanks-Morse heavy-duty Diesel engine which has proved its efficiency and economy in power plants throughout the nation.



BUY MORE WAR BONDS

DIESEL LOCOMOTIVES • DIESEL ENGINES • GENERATORS • MOTORS • SCALES • PUMPS • STOKERS • RAILROAD AND FARM EQUIPMENT

FAIRBANKS, MORSE & CO., CHICAGO 5, ILLINOIS

Do You Realize...

- THAT EVEN A SHORT PIECE OF PIPE WILL EXPAND WITH AN INCREASE IN TEMPERATURE?
- THAT IF THERE IS A "STIFF" CONNECTION, THE STRESSES SET UP WILL BE TREMENDOUS?
- THAT YOU MUST PROVIDE FOR THE EXPANSION?

Don't assume, because the pipe is short, there is no need to worry about expansion. This may be true if the arrangement of the piping is such that the expansion can be taken care of by a spring connection without unduly stressing it. But, often the piping is "stiff" and then expansion stresses may be introduced which are greater than the pipe or fittings can withstand.

Don't take this chance. Install ADSCO Internally Guided Expansion Joints. Noted for their mirror smooth slips and well machined sliding surfaces that insure smooth, efficient operation and a minimum of wear. Write for illustrated bulletin No. 35-30 E.

Above fittings were continually breaking before ADSCO Expansion Joints were installed.

AMERICAN DISTRICT STEAM COMPANY
North Tonawanda, N.Y.
MAKERS OF "UP-TO-DATE" STEAM LINE EQUIPMENT FOR OVER 60 YEARS

CONTROL EXPANSION WITH ADSCO INTERNALLY GUIDED EXPANSION JOINTS

Available for pressure up to 300 lbs. — temperatures up to 750°. Traverses up to 12" per slip. Furnished in single or double slip — flanged or beveled ends—with or without bases, service outlets and drip connections.

With a short connection there is little danger of buckling, and so complete guiding in general is not required. ADSCO Internally Guided Joints are entirely adequate for this service and the price is moderate.

ADSCO EXPANSION JOINT ELIMINATES CUMBERSOME PIPE BENDS

Protect Your Boilers Against Pitting, Corrosion and Scale with

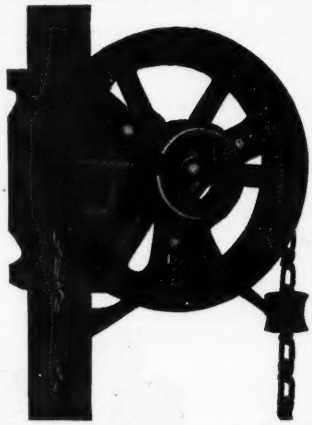
Magic
BOILER PRESERVATIVE

Write for Descriptive Bulletin

- This modern boiler preservative contains colloids that possess adsorptive properties. It holds all precipitates in suspension, while at the same time establishing a protective colloidal film on the metal to arrest pitting and corrosion. Its action is simple, safe, sure; helps your boiler produce more steam.

GARRATT-CALLAHAN CO.
OF ILLINOIS Established 1904 OF NEW YORK, Inc.
CHICAGO—59 E. Van Buren St. • NEW YORK CITY—1328 Broadway

Think of the TIME You'll Save



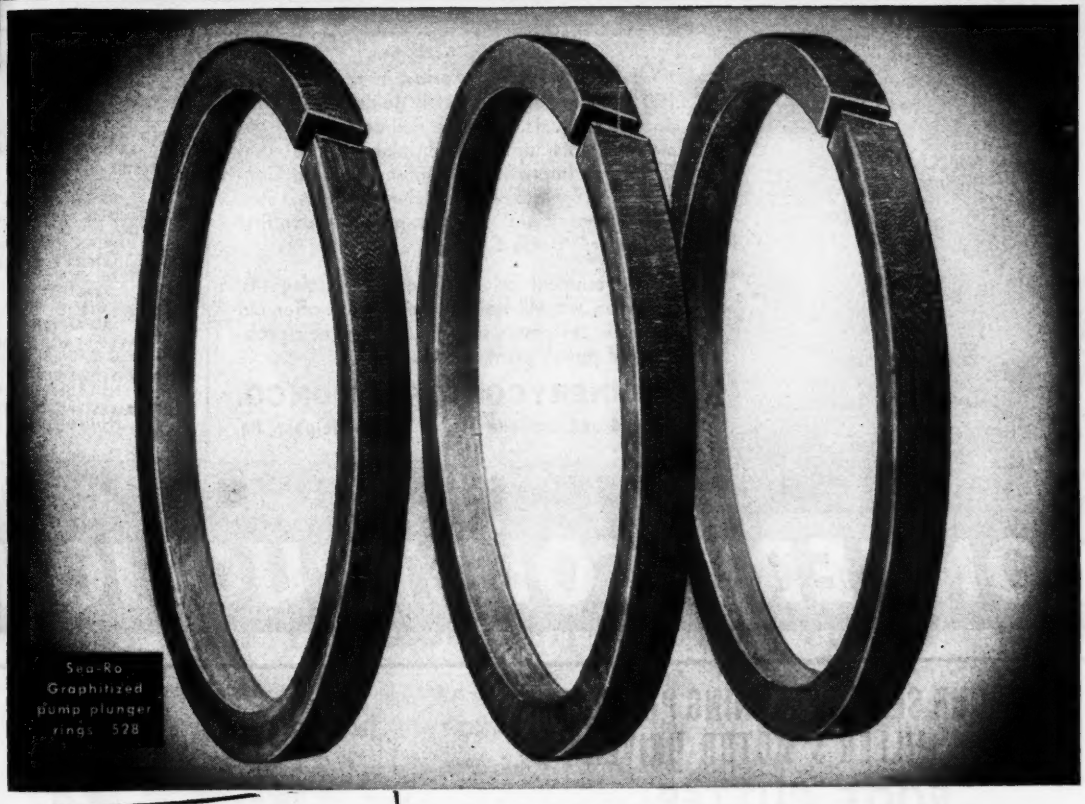
with Babbitt Sprocket Rims on all your "high-up" valves. No need of keeping a long, cumbersome ladder always on hand just to close a valve.

Babbitt Rims give you instant and positive control of overhead valves from the floor—save time, steam and accidents. Adjustable to any valve, easily attached and low in cost. Don't delay. Get your Babbitt Rims now! Complete information on request.

BABBITT STEAM SPECIALTY CO.
South Water, Spring and First Sts.
New Bedford, Mass., U. S. A.

Babbitt
—Adjustable—
SPROCKET RIM
with Chain Guide

PROVEN PERFORMANCE
UNDER HIGH TEMPERATURE



1½ YEARS' SERVICE ON NAVY CORVETTE

Installed January, '43 in a U. S. Corvette's feed pumps, Sea-Ro rings easily withstood 400 lbs. pressure and 260° F. temp. for full year and a half.

Install these GRAPHITIZED PUMP PLUNGER RINGS *on the tough jobs!*

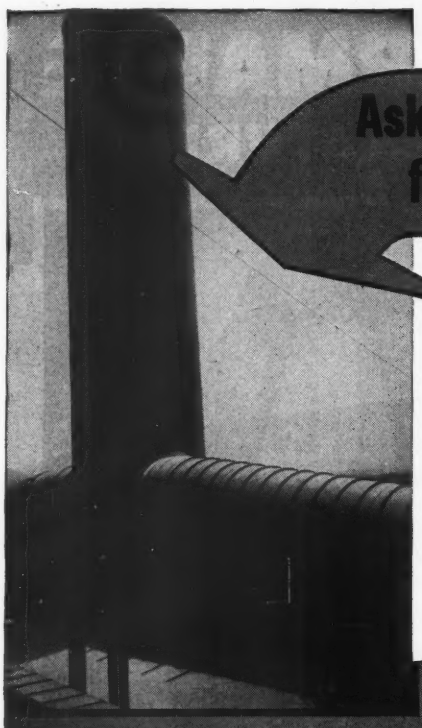
Reports recently received from Sea-Ro installations on "tough jobs" prove these pump plunger rings stand up under high temperature. But it's no wonder. Sea-Ro graphitized pump plunger rings are made of a strongly laminated plastic composition, engineered specifically to meet the need for a long-wearing, low friction, resilient, light-weight ring. Sea-Ro rings are of the "floating type". They resist abrasion and strain and are unaffected by most solvents, oil, and reagents.

Give them a trial. Rings are precision-ground to meet your exact specifications.

SEA-RO

PUMP PLUNGER RINGS
NEK-SEAL PACKING

SEA-RO PACKING CO. • WOOD-RIDGE • NEW JERSEY



Make Your Power Plant Building Dollars Buy Leakproof, Long-Lasting Construction . . .

Ask for a Connery Bid on those future Stacks or Breechings

WE take pardonable pride in the fact that 100% of Connery output is going to war production projects. And we feel certain that the many plants using (and planning to use) Connery's Improved Expansion Stiffened Construction for stacks, breechings, ducts, etc., won't mind if we give our best to "our first customer," Uncle Sam.

As government priority construction slackens, however, we will be in a position to offer old and new customers specific help on their problems of power plant construction.

CONNERY CONSTRUCTION CO.
Second and Luzerne Sts. Philadelphia, Pa.

Recent Installations

NEW HAMPSHIRE GAS & ELECTRIC CO. PORTSMOUTH, N. H.
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EXPANSION STIFFENED

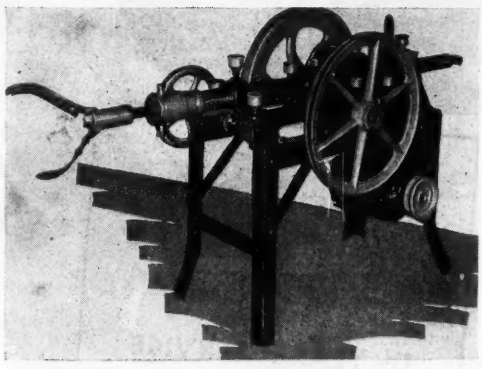
CONNERY CONSTRUCTION

LICK YOUR SEWER CLEANING PROBLEMS WITH MILLER'S MOTOR-DRIVEN ROOT CUTTER

Capable of cutting left and right through roots and stoppages from sewer tiles 4 to 12 inches in diameter. This machine is motor driven and can also be operated by hand where electric power is not available. It is equipped with three 50 ft., 3/16 inch Steel Cables. The cable has an inner liner which prevents rod from kinking in pipe line and will easily make 4 inch quarter bends.

Literature on complete Root Cutting Machine Outfit, Including three 50 ft. cables, two couplings, and set of cutters for 4 to 6 inch sewers will be sent on request.

J. C. MILLER TOOL SALES
5914 WILSON AVE. CHICAGO 30, ILL.



LUBRICATE ENGINES, PUMPS, COMPRESSORS with DEPENDABLE MANZEL LUBRICATORS

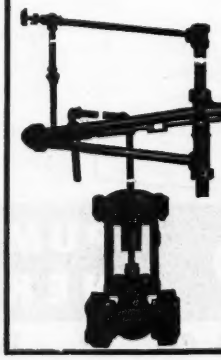
Model 25

Avoid unscheduled shut-downs and time-consuming overhauls by lubricating your engines and heavy machinery with Manzel Force Feed Lubricators. Any good oil will give cylinders and bearings maximum protection when delivered by Manzel Lubricators.

These dependable, accurate metering pumps start, stop, speed up and slow down with the engine or machine. They deliver exactly the desired amount of oil on each pump stroke. Feed is easily set and very accurate.

Write for catalog 25-D

MANZEL BROTHERS COMPANY, 327 Babcock St., Buffalo 10, N. Y.



Squires

Boiler Feed Water Controllers maintain a constant water level in your boilers, feeding them in proportion to evaporation.

Let us send you Circular E-12

THE C. E. SQUIRES CO.
E. 40th St. and Kelley Ave.
Cleveland, Ohio

Preheat with Paracoil Self-cleaning Fuel Oil Heater

ENGINEERED FOR PRECISE PERFORMANCE . . . Paracoil heaters deliver fuel oil to the burners at a definite and uniform temperature. Vertical baffles scientifically spaced direct the fuel oil transversely across the heating surface, thus promoting turbulence, essential to thorough preheating.

SELF-CLEANING . . . A simple, fool-proof, manually-operated internal device permits cleaning of the heating surface without interrupting flow of oil.

A SIZE FOR YOUR NEED . . . There is a Paracoil heater of proper size to supply your requirements. Paracoil heaters definitely will eliminate one of the major conditions responsible for wasteful combustion of precious fuel oil.

ECONOMY . . . Economies effected absorb initial cost—the only cost.

WRITE FOR THE DESCRIPTIVE, ILLUSTRATED PARACOIL BULLETIN HE-100.

SINCE 1915
Paracoil
HEAT TRANSFER EQUIPMENT

DAVIS ENGINEERING CORPORATION
1068 EAST GRAND STREET, ELIZABETH 4, NEW JERSEY

MITCHELL *Fabricated* PIPING

WITH THE LATEST IN

POWER PIPING DESIGN

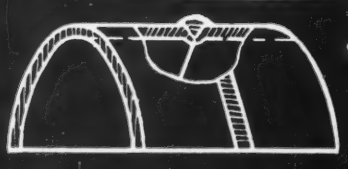
including the New

WESTPORT WELDED JOINT

FOR ALL PRESSURES AND TEMPERATURES

Complete penetration with smooth, sound welds providing streamline interior contour and *without* the use of Backing Rings which may obstruct flow or sacrifice pipe wall strength with unnecessary machining. Write for bulletin describing in detail advantages of Westport Welded Joint.

1899 1944



W. K. MITCHELL & CO., Inc.

PHILADELPHIA 46, PENNA.

Fabricators and Erectors
Specialists in Alloy Piping

WARM UP *the* COLD SPOTS

WITH YOUNG UNIT HEATERS

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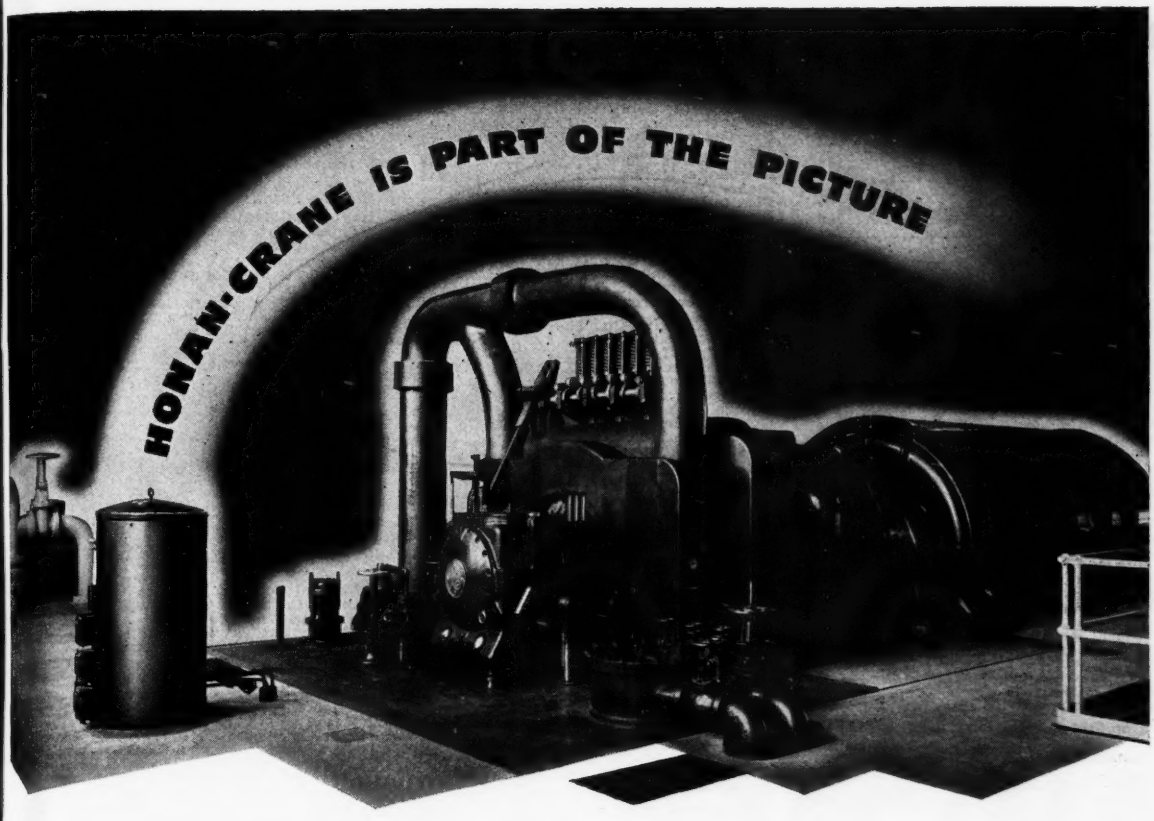

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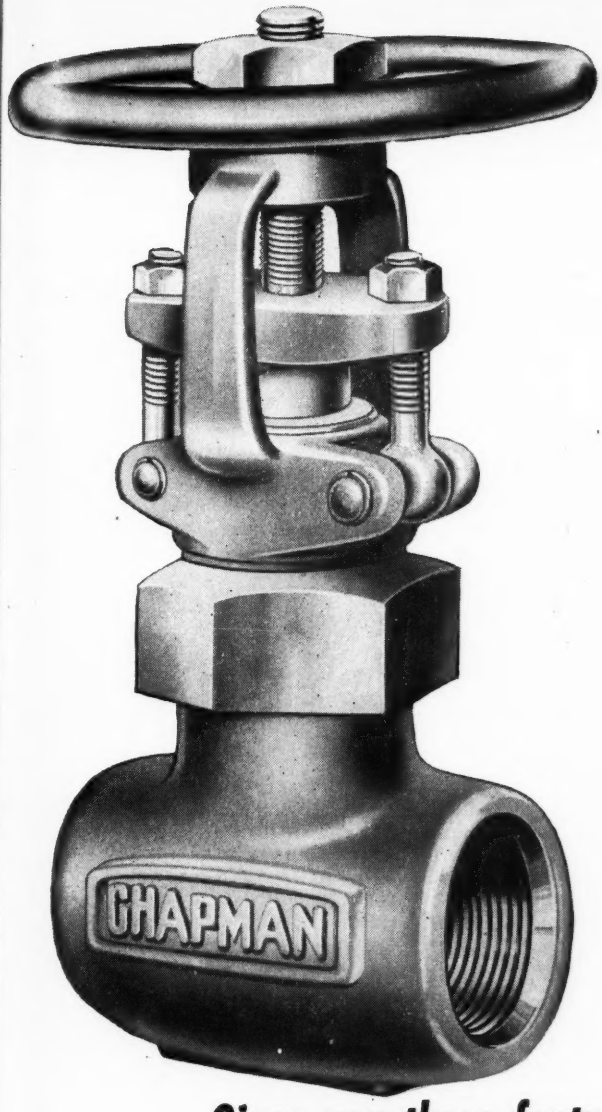

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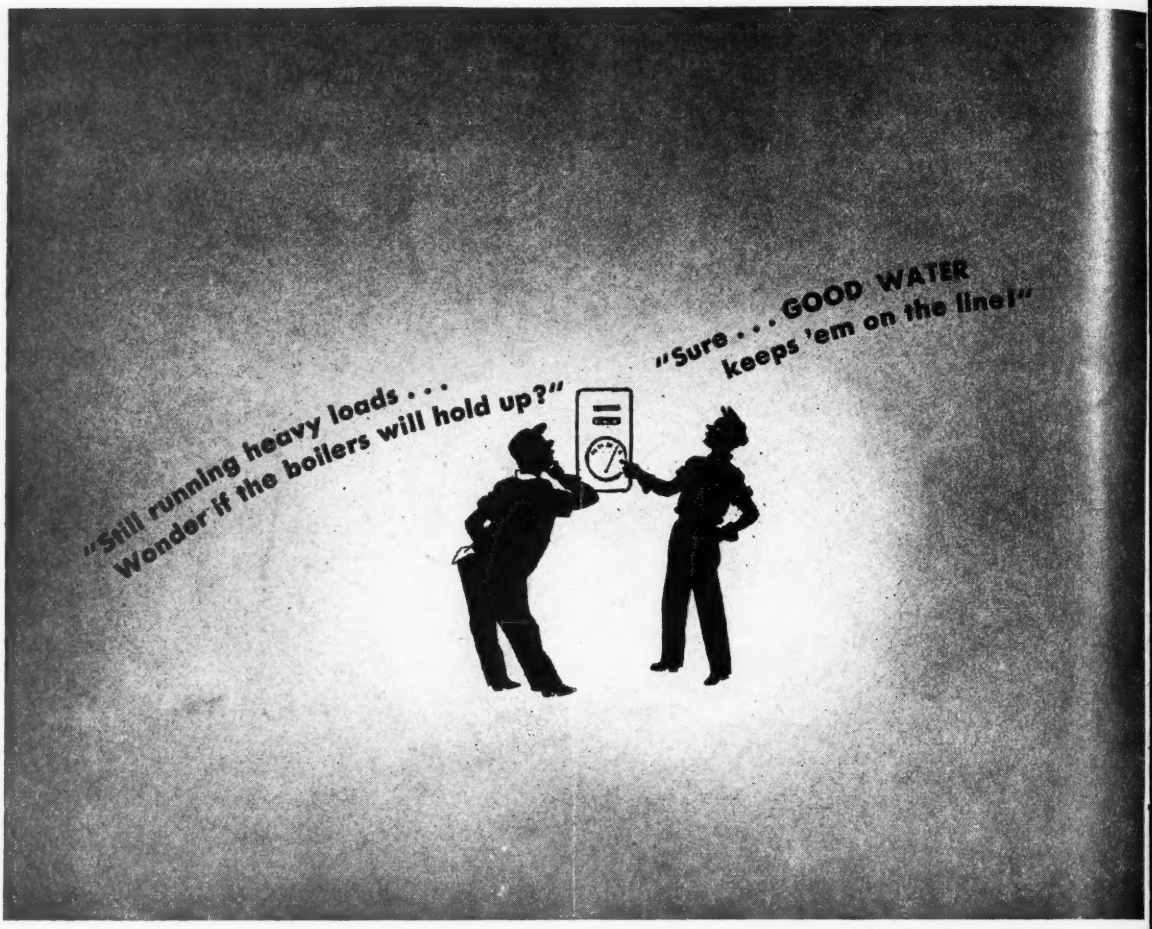

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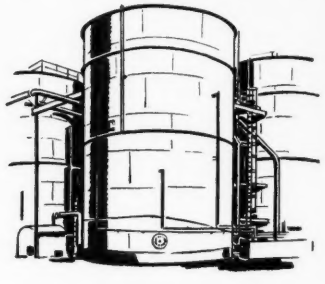

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